Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, APRIL 16, 1904. No. 16.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you, If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3,00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico - - - - - -	Per year, $3.00
Foreign Countries, within the Postal Union - - - - - -	6.00
Great Britain and Ireland - - - - - - - - -	25 shillings
Germany - - - - - - - - - - - - -	25 marks
France - - - - - - - - - - - - -	31 francs
Single copies - - - - - - - - - - - - -	.10

Remittances for foreign subscriptions may be made through our European office.
In requesting your address changed give OLD as well as new address.

Copyright, 1904, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, APRIL 16, 1904.

CONTENTS.

Editorial 717
British Views of American Technical Education 720
Union Engineering Building 720
Irrigation Plans in California 720
Telegraphy in Central Africa 720
New Radioactive Elements 720
A Long-span Transmission Line. By B. Wiley 721
Streamers or Side Discharges from Electrodes. By Alfred G. Dell 722
The Efficiency Curves of Constant Potential Transformers. By A. E. Kennelly 723
The Evansville Municipal Telephone Scheme Illegal 724
Theoretical Determination of Power Curves 725
The Uses of Natural Gas 727
Serious Subway Fire in New York City 727
The General Electric-Allgemeine Electricitats Gesellschaft Combination 728
Electric Automobile Wagons 730
Washington Meeting American Electrochemical Society 732
Magnet Steel 736
New Telephone Patents 737
St. Louis Street Railway Convention 738
The Metric System 738
LETTERS TO THE EDITORS:
Individual Motor Drive. By H. H. Cutler 739
Oerlikon Vertical Motor-Generators. By E. Huber 739
The Telephone Receiver in Electrical Measurement. By H. Ho 740
Digest of Current Electrical Literature 740
New Books 744
Steam Turbine Power Plant for Boston Navy Yard 745
Wireless Telegraphy in the War 745
Fuse Plug Cabinet Panels 746
Punch and Shear Motor-Driven 746
Direct-Connected Electric Pump 746
News of the Week 747

FEASIBILITY OF PIPE GALLERIES.

The serious accident and fire which occurred last week at Fulton Street and Broadway, New York City, throwing out of operation for some time thousands of telephonic and telegraphic circuits, must necessarily revive discussion as to pipe galleries and the best means of preventing such accidents. The manner in which Broadway has been excavated for the underground road has foreboded some such disaster as this, more particularly because the electrical cables have been deprived of their wonted conduit protection. As a matter of fact, this accident has been regarded as an argument in favor of pipe galleries, but it seems to us that this is a view of the case hardly justified by the facts. If these telephone and telegraph cables had not been disturbed from their normal location, they would have been enclosed in the usual fire-proof brick manhole and in fire-proof ducts. The cables would have been stood neatly against the walls of the manhole and would not have been surrounded by inflammable burlap and by the mass of woodwork which fed the flames. Now, in most of the pipe gallery schemes which have been discussed from time to time, the plan has been broadly that of carrying the cables in masses through an open tunnel, thus exposing them throughout their entire length to the danger of just such an accident as that which has occurred and which will inevitably occur again unless greater care is taken.

Another view of the pipe gallery question suggested by this accident brings up, apparently, a danger of the first magnitude. If in such galleries there should also be carried with the electrical conductors enormous gas and water mains with their various connections, the liability to fire, flood and explosion would appear to be seriously enhanced. With a big gas pipe broken, the gas rushing forth in vast volume and mixing with the air in the pipe gallery would, if ignited, as it undoubtedly would be, cause a pretty lively concussion. A sensational Sunday journal might easily depict without a great strain of the plausibilities an explosion the whole length of Broadway under such conditions, tumbling into the street like a pack of cards the sky-scrapers with which it is lined. On the other hand, the bursting of a water main might drown out like a lot of rats the passengers in nearby subway trains before they could be extricated.

At first glance, the pipe gallery idea has many recommendations, particularly in the ready accessibility of the various services and the facility with which new services can be installed, thus, for example, rendering new competition feasible, which to-day does not appear easy to effect. On the other hand, it does seem as though in working out a pipe gallery scheme, the first consideration should be given to dividing up the services rather than bunching them, so that as in a sectional water-tube boiler, the danger would be lessened rather than increased. The grave financial, legal and other problems of the gallery are, moreover, to be borne in mind before any such plan could be adopted, and the subject is well worth the closest consideration that the best engineering minds can give it. At first glance the pipe gallery appears to be a ready solution of many troubles, high in the list of which is the present abominable and incessant ripping up of the streets. On the other hand, as this accident of last week suggests, it is most desirable that the remedy should not be worse than the evil attacked.

TRANSFORMERS EFFICIENCY CURVES.

Elsewhere we print an article by Dr. Kennelly which embodies an elegant treatment of the subject of constant-potential transformer efficiency. Assuming that the excitation losses are constant—which assumption appears entirely valid within practical limits—it is shown that, having the test curve of a transformer, by a simple geometrical construction, the relation between, and the values of, the several factors of loss may be readily determined. This follows from the demonstration given that at the point of maximum efficiency the excitation and I^2R losses are equal, and at this point the drop of pressure in the transformer resistance is half the drop of efficiency. These conclusions follow from the fact established that, under the above assumption, the efficiency curve of a constant-potential transformer is an acute hyperbola, having for one of its asymptotes a straight line representing only the copper loss. It is to be hoped that Dr. Kennelly will publish the application of this treatment to the case of constant-potential shunt motors and generators even if, as stated, the limits of accuracy are less; for it will have much value in putting in a new light the fundamental principles of such apparatus.

AN EXAMPLE IN LINE DESIGN.

Mr. Wiley's brief article on another page is a capital sample of the art of line calculation under rather trying conditions. It is very seldom that a construction such as described is necessary or justifiable. In the first place, 250 volts is a pressure seldom to be advised for a motor distribution in large units; and in the second place, it is extremely unusual to be obliged to go to the long span construction with so heavy cables as in this case. However, given the conditions there was nothing for it but to go ahead and run the spans, and this seems to have been done in a very workmanlike manner. The only thing which we should be disposed to call in question is the sufficiency of the factor of safety considering the use of material having a rather low and uncertain elastic limit. We hope that some one competent for the work will take up the investigation of the elastic limit of electrical aerial conductors, with particular attention to the elongation factor. Aluminum has very obvious advantages for long span work by reason of its small weight and relatively good conductivity, yet from all the data now at hand we should hesitate to use it with quite the same factor of safety used for copper. However, in this case the proof of the pudding is in the eating and a few seasons of storms will show whether the strain is a little large for the elastic limit or not. One thing we hope Mr. Wiley will follow up carefully, and that is the actual as compared with the theoretical deflections. The expansion of wires under considerable tension has been very inadequately studied, and the behavior of aluminum cable under this condition is extremely well worth investigating. The sag of a long catenary is a wonderfully sensitive index of the coefficient of expansion, the temperatures are easily obtained from resistance measurements, and the resulting data are highly desirable. On many transmission circuits the use of long spans is being considered to cheapen line construction and to lessen the number of insulators. Aluminum is the material usually chosen for such constructions, hence an exact knowledge of its behavior under practical conditions is really important. We trust Mr. Wiley will make good use of his opportunities and take regular deflection measurements at intervals through the next year. The results will be most instructive.

THE PREPARATION OF MATERIAL FOR STANDARD CELLS.

Two interesting papers presented last week before the American Electrochemical Society, the one by Profs. Carhart and Hulett, the other by Dr. Wolff, deal with the precautions that are necessary in order to insure electrochemically pure mercurous sulphate. A substance such as mercurous sulphate may be defined as being electrochemically pure, when its electromotive force is zero with respect to the same substance chemically pure. In order to procure electrochemically pure mercurous sulphate, the authors of both papers arrived independently at methods identical in all essential points. They use a process for producing the crystals at the anode. This is just the reverse of the ordinary method of depositing metals from salts. Profs. Carhart and Hulett went further and prepared and tested cadmium cells in which the electrolytic mercurous sulphate was used. Judging from the results reported in the manufacture of cadmium standard cells using the electrochemically generated mercurous sulphate, the authors are to be congratulated on their success. Some extended experience will, however, probably be needed before the final success of the method can be determined. The saturated solution cadmium cells thus produced appear to have an e.m.f. of 1.01908 international volts at 21.1° C. This is an e.m.f. of six significant figures. If we can even get four digits quite correct we can afford to smile gently upon the fifth and sixth, so far as concerns ordinary industrial requirements.

WEAK SPOTS IN THE PATENT SYSTEM.

Our American patent system is, on the whole, perhaps as good as any other, yet one cannot have much personal experience with it or long watch its operations without realizing that it has some serious failings. To one of these we referred recently, namely, the practice of granting patents on current engineering development. Another conspicuous defect is the absence of any provision compelling the patents to be worked even in the most perfunctory fashion. Of course, this failing seems to be in the direction of liberality toward the poor inventor, but we very much question whether in the long run this apparently benign provision works to the inventor's benefit. At the present time almost every class in the Patent Office is rich numerically, in inventions. An attempt to work up the state of the art in almost any line discloses large numbers of more or less conflicting patents running back over a long term of years. Of these very few are fundamental in their bearing upon the art. Most of them are interlinked with their predecessors in a more or less complicated fashion and belong in the category of improvements. But of the whole mass of patents, primary and secondary, only a very small percentage have any record of practical usefulness. The vast majority is composed of patents unsuccessful and entirely unworked, or of patents taken out for purely defensive purposes, and never seriously intended to be worked. The result is that the inventor honestly striving to produce an article of industrial importance continually finds his way blocked by prior patents touching his invention, more or less remotely, but still sufficiently in the way to hinder material improvements or to control them if made. Even if the way be not completely blocked, it is so far obstructed as to make it difficult to get proper claims, or even claims sufficient actually to protect the new invention. How to avert this trouble is a very serious problem.

We are more than half inclined to the opinion that some requirements for working should be introduced in our patent system at the first opportunity for the purpose of giving the public and particularly inventors of improvements a fair show. The technical working required in some countries abroad is altogether insufficient since it is only necessary to go through the motions without really doing anything by which the public can benefit. Something considerably more drastic in the way of a remedy is needed to really put the unused patents and those held up for litigious purposes finally out of action. We should almost be inclined to favor a primary term of not more than seven years, followed by a reissue for a similar period on the presentation of evidence sufficient to show to the office that the invention is actually being manufactured and sold in the open market in good faith and in quantities sufficient to adequately meet current demands. At the expiration of this reissue term, a second similar reissue might be permitted after a somewhat more stringent inquiry. In case reissue were denied the patent would

simply go out of existence and the invention would at once become public property. Such a scheme would eliminate all the dead failures and most of the patents held for obstructive purposes, either on paper or in reality, and would clean the way for improvements. It would obviously have been made, if in existence, to clear up some of the most celebrated tangles of recent years, and it would certainly tend to lessen the mass of fruitless litigation that now burdens our patent system. It, of course, throws heavy responsibility on the officials in charge and opens the way for some perhaps questionable decisions, but after all we have to depend on the office for the original patents themselves and for the present reissue system, and the responsibility is seldom abused. With the immense mass of patents that has been accumulating some sort of relief is absolutely necessary if the march of improvement is to continue unobstructed. The details of any proposed system of relief naturally require to be worked out with great care, and we are far from proposing a simple panacea to meet all cases; yet some means ought to be provided for getting unused and unsalable patents out of the way without waiting seventeen years for them to die of old age.

MOLECULAR CONDUCTIVITY.

In a paper presented last week before the American Electrochemical Society, Mr. C. J. Reed attacks the definition and customary text-book enunciation of "molecular conductivity." There is certainly force in Mr. Reed's argument. It seems indisputable that the definitions and statements current in electrochemical text-books relating to "molecular conductivity" are loose, and out of conformity with the definition and statements adopted in physics for conductivity. It is very desirable that this evil should be eradicated and electrochemical dicta brought into conformity with those of general physics. On the other hand, Mr. Reed, after demolishing the theoretical basis of the term "molecular conductivity," as used by electrochemists, takes the position that all theoretical deductions based on investigations of "molecular conductivities" have no physical significance. By this we suppose he means that they are scientifically meaningless, valueless and heretical. Here we have to differ with him. We think he goes too far when, after hacking the definition to pieces, he throws overboard the whole idea framed in the definition. As usual in such cases, it is a matter of language. We think the ideas are valuable, represent important scientific facts and should be carefully preserved. The language of the definition is at variance with physical terminology, and since the latter is to be regarded as of earlier foundation and logically sound, the more modern electrolytic phraseology should be amended in such a manner as to conform therewith.

In electromagnetics, a resistance is a quantity that in absolute measure must be expressed in absohms, or the units which may be called absolute ohms; while in practice it is measured in units a billion times as big; i. e., in ohms. Resistivity is a specific property and may be defined as the resistance of a unit cube of the substance between opposed parallel faces. Such resistivity to be in absolute measure, must be expressed in absohm-centimeters; or, if expressed in practical measure, must be in ohm-centimeters. Conductivity is the reciprocal of resistivity, and, in absolute measure, must find of matter in regard to resistance when referred to unit dimensions, expression in abmhos per centimeter, or the units implied thereby; while in practical measure it must be in mhos per centimeter. The conductivity of a homogeneous material may be defined as the conductance of a unit cube of the material between any pair of opposed faces. Of course, no man can be compelled to express the conductivity of sea water in the units above-named. He may express his conductivity in terms of the conductivity of mercury (at a standard temperature), for example. It would be perfectly correct to do so; but it would not be the international physical system of measurement, which is the C. G. S. system. In the C. G. S. magnetic system there is one and only one unit for any one physical quantity, and conductivity must, in that system, be measured in terms of the unit which we have described as the abmho-per-centimeter. This name is open to dispute, but the unit is beyond dispute. In precisely similar fashion we may express the velocity of light in any definite unit that we please, such, for example, as cubits per hour; but if we state it in the international physical system there is one and only one unit—the centimeter per second.

Electrochemists theoretically determine molecular conductivities of solutes in aqueous solutions by taking a thin tank of glass, the side walls of which are parallel, vertical and 1 cm. apart. They electroplate or apply electrodes to these walls, so as to have the electrodes parallel, vertical and 1 centimeter apart. Whatever the density of the solution to be tested may be, they pour in enough of the solution to contain one gram-molecule of the solute. For example, with potassium chloride solution, they pour in as much as contains 74.5 grams. They then measure the conductance of the electrolytic cell and express it in terms of the conductance of a prism of pure standard temperature mercury—1 meter long and 1 sq. mm. in cross-sectional area. They call the result the molecular conductivity of the solution for that particular dilution. Of course, we do not mean that the process is actually conducted in the above manner, but we believe that it may be properly conceived of as being so executed. There is nothing in all this to criticize except the definition. What is measured is essentially a conductance multiplied by an area, expressed in absolute measure in abmho-sq.-cms.; or in practical measure in mho-sq.-cms. It is not consistent with electrics or the electrical department of physics to call the quantity arrived at a "conductivity." If it is called a conductivity, then this conductivity is inconsistent with the ordinary conductivity of electrics, a quantity which can only find expression in the absolute unit that we may call an absohm-per-centimeter.

The quantity which the electrochemists derive is a conductance multiplied by an area, or a conductivity multiplied by a volume. The same quantity may in fact be derived by measuring the resistance (between parallel faces), of a cubic centimeter of the solution, determining the corresponding conductivity in mercury units, and then multiplying by the volume of solution in cubic centimeters which would contain a gram-molecule. The quantity is, therefore, correctly expressed in current physical terms, either as a conductivity volume, or a conductance area. In absolute measure it must be expressed in the unit which may be called an abmho-square-centimeter. But whatever this unit be called, it is the only unit which can be used if we are to keep in the international C. G. S. system. No particular harm is done by calling the quantity a molecular conductivity, until we begin to think about conductivities as defined in the ordinary way, and then a clash becomes inevitable. No error would be involved if the quantity were rechristened "molecular-volume-conductivity," or "molecular-conductivity-volume." All propositions now enumerated concerning molecular conductivities could then be made concerning molecular volume-conductivities without any danger of inconsistency. In any case it seems unnecessary to retain the old Siemens mercury unit, or the specific resistance of mercury, in the definition. It may be troublesome to reconstruct tables which have been laboriously prepared in terms of mercury, but after all, part of the business of construction is reconstruction, and the old order giveth place to new. The pride of science lies in its junk heap.

British Views of American Technical Education.

In a cable account of the report of the Mosely Education Commission, which recently visited this country—which consists of a large volume containing the separate reports of the twenty-six commissioners—the New York *Sun* says that the commissioners have much to say about the relations between education and industry, and the reliance of manufacturers on the schools for the best and brightest men, while the highly trained lads from the technical schools in England find difficulty in getting employment in a manufactory. The commissioners think that engineering students in the United States stay too long at school, and, according to Prof. Armstrong's view, overteaching is the bane of American schools of every grade.

Prof. Ayrton makes the following comparison of results: "The American student usually is not as scholarly nor as well read as the English student of the same age, but he has his knowledge in a better form to apply. The British system turns out a man full of knowledge and principles, while the American product is a business man with a scientific training. The characteristics of each nation have their advantages.

"To America we look for that rapid, bold and successful application of science to industry which has brought about the commercial invasion of the world; while to Europe we look for those scientific imaginings and creations which apparently are so unimportant to-day, but which to-morrow revolutionize old industries and give birth to new ones."

Mr. Blair, of the Irish Department of Technical Instruction, writes that the best ability in the United States is not to be found in the professions and in politics, as in Great Britain, but in the industries and in commerce.

Among the general conclusions are the following: That while education is not the prime cause of the remarkable progress during the last thirty years in America, it is a powerful contributory cause and the essential condition of its maintenance; that the root of educational progress in America and the secret of any superiority that its institutions possess lie in the good will of the people and the universal belief in the value of education, and that there is nothing like finality in American educational institutions any more than there is in the British.

Union Engineering Building.

In order to enable the three national engineering societies to avail themselves of Mr. Carnegie's gift of a building for headquarters and library purposes, etc., the conference committee has had drafted a bill incorporating what is known as the United Engineering Society to hold the property for the societies. This bill was introduced in the State Senate by Senator Townsend, of Utica, and has already passed both the chambers, and has gone to the Governor for signature this week. The bill is virtually a transcription of the act incorporating the Cooper Union, its purposes being in most respects, if not all, identical with regard to the public objects of the building.

The conference committee has also selected the following well-known firms of architects who have consented to join in a limited competition for the plans of the Engineering Building, as well as of the Engineers' Club, namely, Carrere & Hastings, Clinton & Russell, Whitfield & King, Ackerman & Partridge, Palmer & Hornbostel and Lord & Hewlett. The committee also expects this week to provide itself with a professional adviser whose assistance it will enjoy in connection with the architectural part of its work. In addition to the six competing firms, each of whom will be paid for its plans, there will be an open competition in which the leading competitors will be compensated by four prizes. It is believed that this mixed competition will furnish the committee with a wide range of desirable designs. Some of the best firms of architects do not enter these competitions, but it was Mr. Carnegie's wish that the matter should be put on this broad basis.

During the absence of Dr. S. S. Wheeler in Europe, Mr. Gano S. Dunn has been appointed by the American Institute of Electrical Engineers as its representative in his place on the conference committee. Mr. Dunn is a member of the Institute council.

Telegraphy in Central Africa.

Some details have been made public recently as to the telegraph line from the Atlantic shore of the African continent to Lake Tanganyika, a distance of about 1,500 miles, for which $600,000 was voted by the Congo authorities. The completed line thus far is only 750 miles long. It took about two years to construct the line from the sea to Stanley Pool, 450 miles. The crossing of wide rivers presented a tough problem. It was nearly a year before the wire was stretched across the widest river between Matadi and Stanley Pool. The river is nearly half a mile wide. Two steel poles were finally erected on hills 2,620 ft. apart. The posts are 50 ft. high and their tops are over 200 ft. above high water level in the river.

Above Stanley Pool to Equatorville, the present terminus of the line, the difficulties were still greater and nearly all the work was done by natives under the direction of Europeans. The most difficult piece of work was the crossing of the Kasai River, the second largest Congo tributary. It was necessary to keep the wire so high that it would not interfere with steamer traffic on the river. Fortunately, where it was desired to cross a rocky island stands in midstream. A high steel post was erected on the island and two others on the banks of the river, so that the crossing was made in two spans, one of 1,472 ft. and the other of 2,198 ft. The wire is suspended about 20 ft. above the smokestacks of the steamers. The posts to which the wire is attached are either of iron or living trees and, therefore, proof against the attacks of white ants; but elephants sometimes knock down the iron posts and every now and then storms throw down trees across the line. Communications are interrupted occasionally for hours at a time by electric discharges during the heavy tropical storms.

Among the minor embarrassments are birds, which make their nests on the wire; wasps, which settle in the insulators, and spiders, that cover the poles from top to bottom with their webs and collect a litter of leaves and twigs.

The line, however, is wonderfully facilitating business and is used both for telephone and telegraph service. Each telegraph station is protected by a squad of native soldiers.

Irrigation Plans in California.

Details have appeared in these pages from time to time as to the use of electric power in connection with pumping and irrigation in California. We now note a further development. A new co-operative water company, to be known as the Anaheim Mutual Water Company, is being started at Anaheim, Cal. Those materially interested in its formation and who will receive the greatest benefit as well as subscribe for the stock are a number of ranchers living between Anaheim and Buena Park. The new company, it is stated, has received sufficient support to assure its success, and the necessary agreements have been drawn up by local attorneys.

The plans provide for developing the water by means of pumping plants. The Edison Electric Company proposes to put down a series of wells in the territory to be covered, and agrees to develop 300 inches of water by June 15 next. Ranchers and others taking stock in the company are to make a deposit of 20 per cent. of the amount subscribed with the First National Bank, which is to be paid over to the Edison Company, together with the additional 80 per cent. Upon the development of the amount of water agreed upon the plant is to become the property of the Anaheim Mutual Water Company, the electric company merely furnishing the power after the plant is completed. The proposed plant will allow one-fourth of an inch of water to the acre, providing for 1,200 acres to be represented in the new company.

Institute Meeting.

The 186th meeting of the American Institute of Electrical Engineers will be held at the Chapter Room, Carnegie Hall, 154 West Fifty-seventh Street, New York, Friday evening, April 22, at 8.15 o'clock. The following papers will be presented: "The Mechanical Construction of Revolving-Field Alternators," by David B. Rushmore; "Contribution to the Theory of the Regulation of Alternators," by H. M. Hobart and Franklin Punga, of London, England.

New Radioactive Elements.

Prof. Charles Baskerville announced last week his discovery of two new radioactive elements in monazite sand from North Carolina. One he calls carolinium and the other Berzelium. These elements owe their development partly to the use of thorium dioxide, and have a higher power of luminosity. He showed the properties before the Chemists' Club. A cable dispatch from London quotes Sir W. Ramsay's prompt appreciation and approval of this work.

A Long-Span Transmission Line.

By B. Wiley.

THE accompanying illustrations show a recently installed 250-volt direct-current power line from the Carrie Furnaces, situated on the Monongahela River, just below Braddock, Pa., to the Homestead Steel Works. The power house is directly back of the pole on the far side of the river, and the point of distribution about 500 ft. from the pole on the near side. The one particular feature is the excessive span adopted, the distance between supports being practically 1,000 ft.

When this problem of line construction was first introduced the three methods considered were as follows:

First, a pole line on the opposite side of the river from the power station to the bridge, shown on the right, across the bridge and down the river to the mill on the Homestead side. Second, a submarine cable system. Third, the present arrangement.

By rough calculation it was deduced that the latter was the most economical, simple of construction, and, from a general engineering standpoint, the most desirable. The span consists of four 800,000 circular mils aluminum cables anchored to steel structural towers on either side of river. These towers are of heavy material and securely braced by four 1¼-in. tie rods. They were made and erected by the Homestead Steel Works. Fig. 1 gives a general arrangement view of the lines, and shows location and height of the towers. The details of attachment of cable to the towers are shown in Fig. 2. The cables were cut to the required length and furnished with aluminum sleeves, *A*, which were clamped to the cable under hydraulic pressure. These sleeves on opposite ends are threaded right and left hand, respectively, and fit copper clevice bolts, *B*. *C* is a steel forging and *D* a strain insulator. *E* is a steel tension bolt for adjustment of sag and *F* represents portion of tower. The leads to and from the cable are flexible stranded wire, and the connection was made by flaring the ends, wrapping them about copper clevice bolts, *B*, and then soldering.

The following extract from Foster's Handbook, as quoted from a publication of the Pittsburg Reduction Company, sets forth very plainly the advantages to be derived in this particular case, by the use of aluminum in preference to copper cables; and the preceding material was selected:

"Aluminum wire, rods and bars will be furnished of 63 per cent. electrical conductivity, which will have an equal tensile strength per unit of area with the copper, and, therefore, with the electrical conductivity equivalent of 48 per cent. of the weight of the copper and sectional area of 160, against the area of the copper section 100. The tensile strength of aluminum conductors will be as 100 for the copper is to 160 for the aluminum. This would mean, if a square inch of copper conductor was used of, say, 32,000 pounds per square inch tensile strength, the equal conductivity area of 1 6/10 in. of aluminum would have a tensile strength of 51,200 pounds.

"It has already been determined that with aerial lines the snow and ice load is practically as heavy on lengths of small wire as upon larger sections, so that no objections on this score can probably be found to the use of the larger section of aluminum wire.

"Both on account of having only 48 per cent. of the weight and on account of having about 60 per cent. more strength, the aluminum conductor could be used in much longer spans between supports and the number of expensive poles and insulators can be materially diminished."

The conditions that form the basis of the calculations are as follows: Line voltage, 250; load to be carried, 800 amp.; drop of voltage permissible, 40 volts; necessary size of copper conductor, 1,000,000 circular mils; necessary size of aluminum conductor, 1,600,000 circular mils; (duplicate lines of 800,000 circular mil cable were used for convenience of construction); maximum sag allowable at 212° F., 35 ft.; maximum wind probable pressure, 40 pounds per sq. ft.; minimum temperature, 20° F.; probable ice coating, ¼ in. thick. The tensile strength of hard-drawn aluminum wire is 35,000 pounds per sq. in.; its conductivity, 63, as compared with copper at 100; and the coefficient of expansion, .0000231 per degree Fahrenheit.

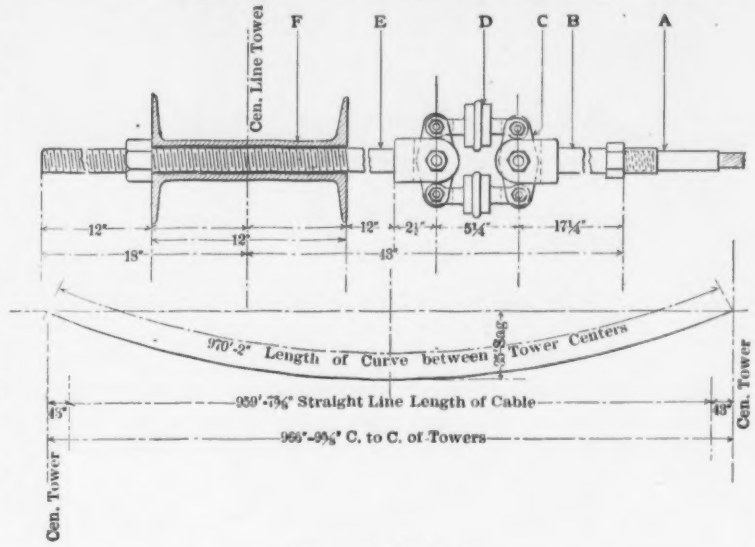


FIG. 2.—DETAILS.

The problem to be considered is, what is the maximum tension in the cable under the most severe conditions as noted above, as compared to the ultimate strength of the cable?

When a wire is suspended between two supports it takes a curve known technically as the catenary. In the case at hand, the catenary comes very close to the parabola, which gives the following relations:

$$T = \frac{L^2 w}{8 d} \qquad (1)$$

Where T = tension in cable at ends,
L = length of span in feet,
w = weight per foot of wire,
d = the central deflection in feet.

Obviously T will be a maximum when w is at its maximum and d at its minimum. The wire will have its greatest weight per foot when coated with ice and is withstanding a heavy wind pressure; and the deflection will vary directly as the temperature.

The weight of 1 ft. of 800,000-cm. A1 cable	=	.736 lbs.
The weight of ¼ ft. ice coating per ft.	=	.389 lbs.
Total weight per ft.	=	1.125 lbs.

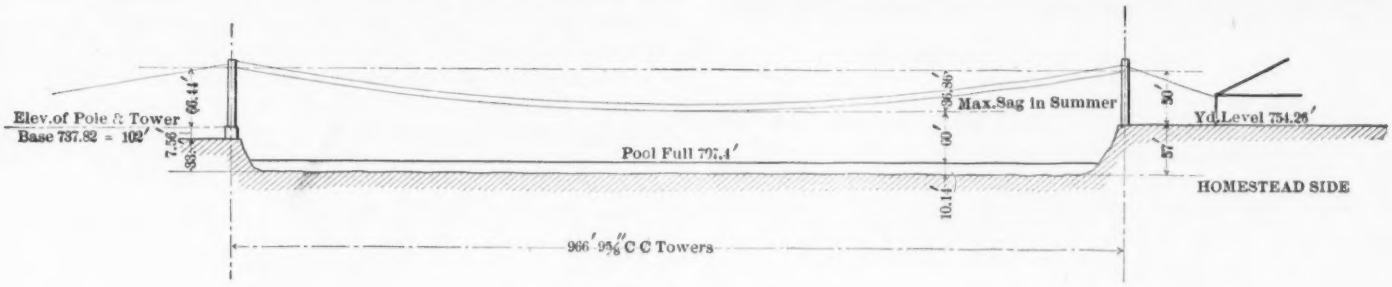


FIG. I.—ELEVATION OF SPAN.

Taking the wind pressure at 40 pounds per sq. ft. and as acting on the cross-section of ice-covered wire, the pressure per foot is 4.166 pounds. As this force acts at right angles to the weight, the resultant force $= \sqrt{1.125^2 + 4.166^2} = 4.31$ pounds, which may be considered the maximum for w.

For the catenary curve, $L' = L + \frac{8d^2}{3L}$.

Where L' = actual length of cable,
L = length of span,
d = central deflection.

Transposing, $d = \sqrt{\frac{3L\,(l' - L)}{8}}$

From these two formulæ, d can be figured for any temperature, the initial sag being 35 ft. at 212° F. The following table gives the sag for temperatures between 212° F. and minus 20° F.:

Temp. F.°	Deflection Ft.
212	35.0
200	34.7
190	33.8
180	33.2
170	32.5
160	31.8
150	31.2
140	30.5
130	29.9
120	29.2
110	28.5
100	27.8
90	27.1
80	26.4
70	25.6
60	24.9
50	24.1
40	23.3
30	22.5
20	21.7
10	20.9
0	20.1
—20	19.2
—20	18.3

Substituting in equation (1) the values,
$w = 4.31$ pounds (the maximum weight),
$d = 18.3$ ft. (minimum deflection),
$L = 1{,}000$ ft.

$$T \text{ (the maximum tension)} = \frac{1{,}000^2 \times 4.31}{8 \times 18.3} = 29{,}400 \text{ pounds.}$$

The sectional area of 800,000-cm. cable is .8 sq. in., giving a tensile strength of $.8 \times 35{,}000 = 28{,}000$ pounds per cable. Comparing

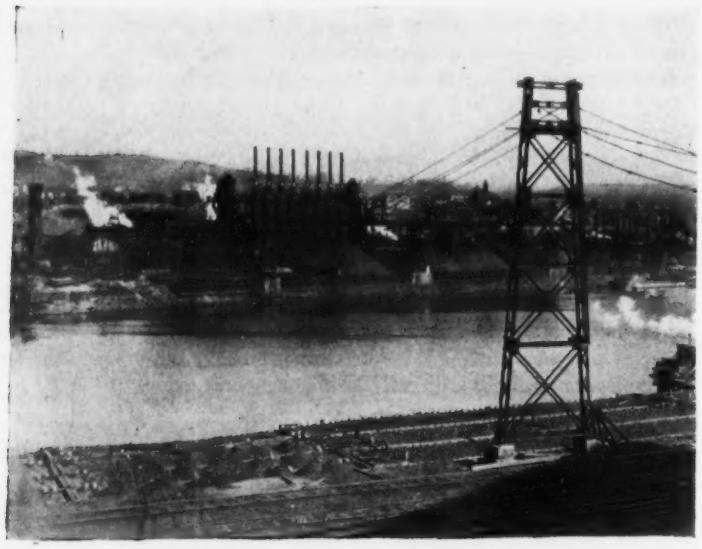


FIG. 3.—VIEW OF ONE TOWER AND THE LINE.

this result with the maximum tension, 29,400 pounds, it is seen that the line will not stand the severe conditions as set down. To relieve the strain, the line should be lengthened in the fall, and, to prevent excessive sag, taken up again in the spring.

Suppose a range of temperature from 60° F. to — 20° F. be taken for the winter. Then the line could be allowed a drop of 35 ft. at this maximum temperature, which by reference to the table, would make the equivalent sag at — 20° F., 28.4 ft.

Substituting in formula (1),

$$T = \frac{1{,}000^2 \times 4.31}{8 \times 28.4} = 19{,}000 \text{ lbs.,}$$

or the one setting would give a safe tension on the cable for the conditions noted; though for severe conditions it would be well to give the maximum drop of 35 ft., as the adjustment requires only a few minutes' work.

As a summation, the maximum strain per cable is 19,000 pounds, or per tower, $4 \times 19{,}000 = 76{,}000$ pounds. The horizontal component due to the wind pressure is transmitted to the foundations and the direct pull to the steel brace rods behind.

The method of stringing the cables was very simple, and may be of some interest to the reader. The cables were wrapped on a large reel, which was set in a securely anchored frame, and arranged to revolve on a shaft. This equipment was placed on the near side of the river. It was provided with a brake, or rather sufficient friction to stop the reel as soon as the tension on the cable was released. The free end of the cable was passed through an ordinary snatch block hung at the top of the near tower. On the far side of the river, just back of the tower, was placed an electrical winch; and, from the drum a 1½-in. hemp line was passed through a snatch block at the top of the tower and carried across the river by a rowboat. The rope was fastened to the cable on the near side and pulled across by the winch, the boat supporting the end and thus being towed back for the return trip with rope for the next cable. When all but a few turns of the cable had been reeled off, a line was fastened a few feet from the end still on the reel. When the end reached the top of the tower, this line was used as a temporary anchor while the bolt was being placed. The 1½-in. line was replaced by a 2-in. line and sufficient slack was then taken up to allow the anchor bolt of the far end to be fitted into place. As these bolts were made extra long, there was still considerable sag in the cable; hence the tension was not great. The bolts were then adjusted to give the required sag. It was about 30 minutes' work to run a cable after starting it from the reel.

Streamers or Side Discharges from Electrodes.

BY ALFRED G. DELL.

In a former article on some of the phenomena of rotating discs, I stated that frequently streamers were seen coming from the electrodes under the discs. I propose to briefly describe some of their peculiarities.

They generally appear coming from one or the other of the zinc electrodes about ⅛ or ¼ in. back of the discharge point. Sometimes there are one or two discharges apparently coming from the inside edge of the electrode, and sometimes they seem to twist around the point. I have noticed that they often follow close to the metal and meet the point discharger, but sometimes they strike the disc, but always inclined towards the direction of the sparks from the points. I have never seen any inclined away from the sparks. It would seem there is some cause besides sharp edges or minute scratches or points, although scratches, etc., encourage their production.

I have tried various ways to prevent them, but have not succeeded entirely. Sometimes they will suddenly cease and there will be no more seen unless the arrangement is changed. I am inclined to think they always come from only one of the electrodes, and never from both. They are exceedingly thin, long discharges. In daylight nothing is seen of them, but in the dusk or dark, with the use of a lens, they are well seen with all their changes. When they strike the disc, they interfere with its rotations. If I knew why they should sometimes cease, I would more fully understand them.

It would be well for those working with an induction coil to be on the lookout for this phenomenon as its effects are injurious to the spark discharge. A low humidity in the boxes containing the discs reduces the effect and sometimes entirely prevents it, which I would suppose is on account of the conductivity of the air being reduced.

I have sometimes thought they might be capacity discharges from the windings of the secondary of the induction coil, something like the residual discharges from Leyden jars. The discharges taking place from only one electrode, be it plus or minus, would seem to strengthen that theory.

Municipal Electricians.

At a meeting of the executive committee of the International Association of Municipal Electricians, April 2, the following papers were assigned, to be read at the ninth annual convention to be held at St. Louis, September 13 and 14, 1904. "Street Lighting, Principles Involved and Systems Used," A. S. Hatch, Detroit, Mich.; "The Limitations of the Telephone for Fire Alarm Purposes," Adam Bosch, Newark, N. J.; "The Inspection of Theatres, from an Electrical Standpoint," Wm. H. Thompson, Richmond, Va.; "Methods of Testing," Walter M. Petty, Rutherford, N. J.

The Efficiency Curves of Constant-Potentia Transformers.

BY A. E. KENNELLY.

An alternating-current transformer of the ordinary constant-potential type consumes a certain amount of power at no load, or with open secondary circuit. This power, expended in the excitation of the transformer, is wasted in hysteresis and in eddy currents. The exciting current is usually so small a fraction of the full-load current that the I^2R losses, or copper losses, in the transformer coils at no load may be ignored.

Under load, it is assumed that the hysteresis and eddy-current losses remain unaltered. This is not quite correct; but it is sufficiently nearly correct for practical purposes. Consequently, the excitation losses may be regarded as constant, or independent of the load, and the loss which increases when the load increases is the copper loss, or I^2R loss, in the primary and secondary coils. Under sensibly non-inductive load, this I^2R loss increases as the square of the output.

Let Fig. 1 represent diagrammatically the windings of an actual

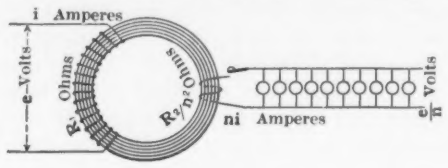


FIG. 1.

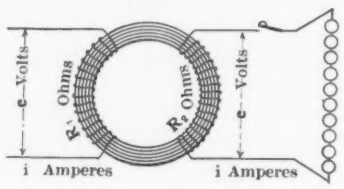


FIG. 2.

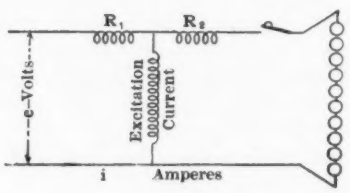


FIG. 3.

transformer, having a primary e.m.f. of e volts and a secondary e.m.f. of $\frac{e}{n}$ volts, where $\frac{1}{n}$ is the ratio of transformation. If R_1 be the primary resistance in ohms, the secondary resistance is $\frac{R_2}{n^2}$, where R_2 is the equivalent resistance of the secondary coil if rearranged with the same amount of copper, but with a number of turns equal to those in the primary winding. If i be the current in the primary coil, and the current of excitation is neglected, ni will be the secondary current.

In Fig. 2 the same transformer is represented ideally as a level transformer, instead of a step-down transformer, the number of turns in the secondary winding being the same as in the primary. The e.m.f. in each circuit at no load is e volts. The current in each circuit under load is i amperes. The primary and secondary winding resistances are R_1 and R_2 ohms, respectively.

Fig. 3 gives the equivalent conductive circuit of the inductive system of Fig. 2. The two coils, R_1 R_2, are in series, while the current of excitation passes through a branch midway between them.

In the diagram, Fig. 4, the derived excitation circuit, with its p watts of constant loss, is separated altogether from the transformer, which is reduced to an equivalent resistance r ohms, delivering a current of i amperes under a pressure of e volts.

The efficiency n of the transformer, as represented by the system of Fig. 4, will be

$$n = \frac{ei - i^2r - p}{ei} \qquad (1)$$

where ei is the input at primary terminals in watts, p the constant

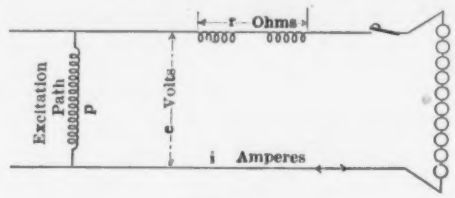


FIG. 4.

excitation loss in hysteresis and eddy currents (watts), while i^2r is the copper loss in both windings taken conjointly.

If n be plotted as ordinates to i as abscissas, we obtain the ordinary efficiency curve, such as that shown in Fig. 6, which is taken from the published data for a 2.25 megawatt transformer.*

This curve of n is a hyperbola. In other words, the efficiency curve of a constant-potential transformer with constant excitation, or frictional losses, is a hyperbola.

Equation (1) may be expressed in the form:

$$n = 1 - \frac{i}{I} - \frac{i_0}{i} \qquad (2)$$

where I is the current strength $\left(\frac{e}{r} \text{ amperes}\right)$ which would flow through the apparatus as represented in Figs. 3 or 4, if the secondary coil were short-circuited and the windings were devoid of reactance.

The current i_0 also represents the non-inductive current, $\frac{p}{e}$ amperes, which would expend, under the pressure e volts, a power p equal to the excitation losses.

In order to show that n in equation (2) represents a hyperbola, let us take the simple case of a transformer in which the constant primary pressure $e = 100$ volts, the total equivalent level resistance is $r = 1$ ohm, and the constant frictional loss is 50 watts. In this case $I = \frac{e}{r} = 100$ amperes; and $i_0 = 0.5$ ampere. Equation (2) becomes

$$n = 1 - \frac{i}{100} - \frac{0.5}{i} \qquad (3)$$

In order to elicit the geometrical meaning of this equation, let us first assume that the frictional loss is made to disappear, so that there is no loss of power in excitation.

Then

$$n = 1 - \frac{i}{100} \qquad (4)$$

This is the equation of a straight line. The straight line is shown in part at $A\,C\,D$ in Fig. 5, where the abscissas are amperes through the transformer assumed as level, and the ordinates are efficiencies. Following the line $A\,C\,D$ and taking 8 amperes (or 800 watts input) as the full load of the transformer, the full load efficiency will be 0.92, or 92 per cent. the efficiency at half load 0.96, etc. Similarly, the full-load drop in the transformer would be $1 - 0.92 = 0.08 =$ 8 per cent., and if the secondary pressure were 100 volts at no load, it would be 92 volts at full non-inductive load, disregarding phase relations. Consequently, if a transformer had no frictional loss, its efficiency would follow a straight line and the line of drop of pressure.

Next suppose, on the other hand, that the transformer has no re-

sistance, but has the assigned excitation loss. Then equation (3) becomes

$$n = 1 - \frac{0.5}{i} \qquad (5)$$

This is the equation of a rectangular hyperbola. The hyperbola is shown in Fig. 5 by the dotted curve *E C F G*. Its asymptotes are the two rectangular, or mutually perpendicular, lines *A B* and *A O*. On this assumption of negligible resistance, the half-load

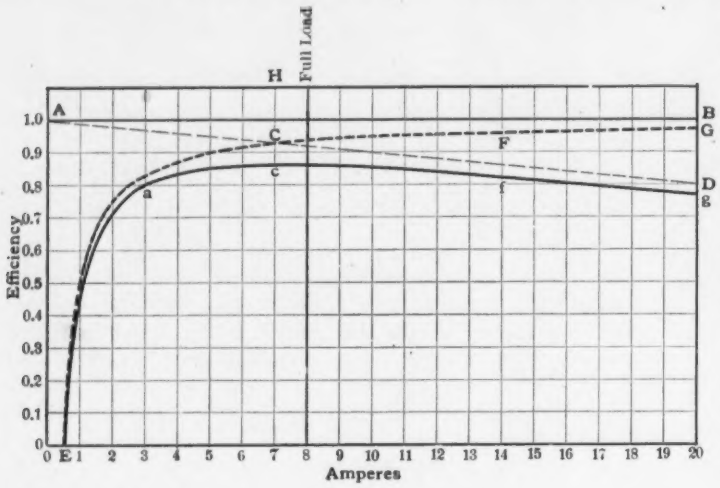


FIG. 5.

efficiency would be 0.875, and the full-load efficiency 0.938. The efficiency steadily increases, the portion *F G* beyond *F* is very nearly a straight line, and the efficiency becomes nearer to 100 per cent. as the load increases.

If now the transformer possesses both excitation loss and resistance loss, as expressed in equation (3) the efficiency curve is the sum of the rectangular hyperbola and the straight line, or becomes

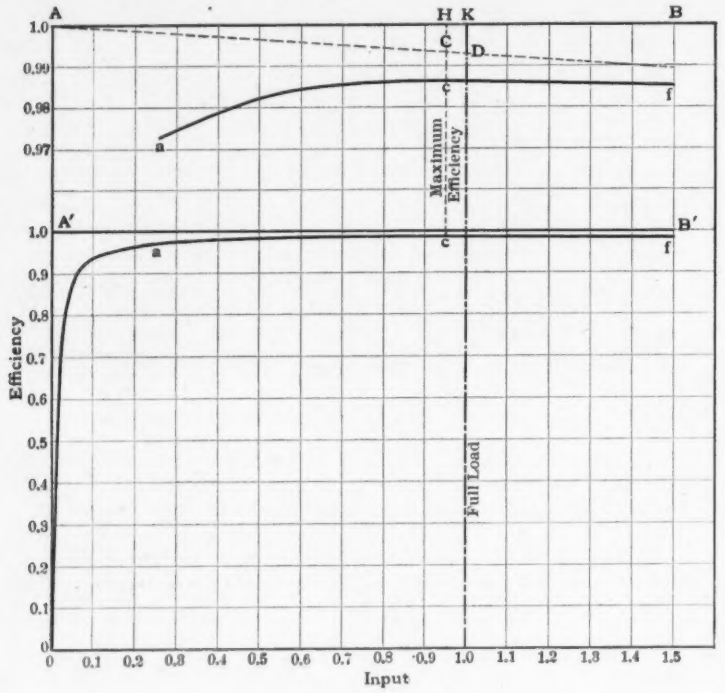


FIG. 6.

the acute hyperbola *E a c f g*, whose asymptotes are the straight lines *E O* and *E D*.

On the hypothesis of resistance loss only, the efficiency continually diminishes with load along the straight line *A C D*. On the hypothesis of excitation loss only, the efficiency continually increases along the rectangular hyperbola, *E C F G*. With the actual transformer of virtually constant excitation loss plus resistance loss, the efficiency rises to a maximum on the acute hyperbola *E a c f g*, at the abscissa where the resistance line *A D* cuts the hyperbola of pure excitation *E C G*. This intersection is at *C* and the maximum value of the efficiency lies immediately below it at *c*. Moreover, the intersection *C* lies midway between *c*, the point of maximum actual efficiency, and the straight line, *A B*.

Consequently, the resistance drop in the transformer at the point *c* of maximum efficiency is half the drop of *c* below the horizontal of 1.0, or 100 per cent. efficiency. Thus, in Fig. 5 the maximum actual efficiency at *c* is 0.8596, representing an efficiency defect of 0.1414, or 14.14 per cent. at a current of 7.07 amperes. The drop in resistance will, therefore, be $\frac{14.14}{2} = 7.07$ per cent. at 7.07 amperes, or corresponding to a resistance of one ohm.

Again, the percentage loss of power in resistance *C H* is seen in Fig. 5 to be equal to the percentage loss of power in friction *C c*, at the point of maximum efficiency. Consequently, at the input of $100 \times 7.07 = 707$ watts, the efficiency defect of 14.14 per cent. represents $0.1414 \times 707 = 100$ watts, equally divided between 50 watts in friction (p), and 50 watts in resistance (I^2R).

The efficiency curve of a constant-potential transformer tells at a glance the amount of power expended in excitation, since this is half the power lost at maximum efficiency. It also tells at a glance the resistance drop in the apparatus, since the resistance drop is half the efficiency drop at the point of maximum efficiency.

As an example of these principles we may consider the efficiency curve of the transformer represented in Fig. 6. The curve in the lower part of the diagram is so nearly flat that it is difficult to point to the maximum; but by using an enlarged scale, as in the upper part of the diagram, it is easy to see that the efficiency reaches a maximum of 0.9865 at *c*, or 95 per cent. of full load. The efficiency drop is, therefore, 1.35 per cent. at this point, and the resistance drop following the straight line *A C D* is $\frac{1.35}{2} = 0.675$ per cent. If this is the resistance drop at 95 per cent. of full load, the full-load resistance drop in the transformer, neglecting phase, is $\frac{0.675}{0.95} =$ 0.712 per cent., or *K D*.

The output at 95 per cent. of full load in a 2.25 megawatt transformer will be 2,140,000 megawatts. Half the efficiency defect at this maximum point, or 0.657 per cent., or 14,100 watts (14.1 kw), will be the excitation loss, and the remaining half will be I^2R loss at this load.

Summing up the above relations we have:

1. The efficiency curve of a constant-potential transformer is an acute hyperbola.

2. The point of maximum efficiency corresponds to equal excitation and I^2R loss, or equal losses in iron and copper.

3. The drop of pressure in resistance in the transformer at maximum efficiency is half the drop of efficiency.

It can be shown that these propositions also hold when the curve is drawn to output as abscissas instead of input.

Similar reasoning applies to constant-potential shunt motors and generators subject to somewhat greater limitations in accuracy.

The Evansville Municipal Telephone Scheme Illegal.

The Evansville Municipal Telephone Company's scheme has been declared illegal by a ruling of Judge Robison, special judge, in overruling the demurrer of the city in the suit by R. D. Richardson to enjoin the city from embarking in the municipal telephone business. The ruling practically disposes of the question.

Judge Robison held that the scheme is illegal because the preferred stockholders are allowed to name certain of the directors, which is contrary to the statute, and that the contract between the city and the telephone company is void because employees of the city are interested in the company as private stockholders. Immediately after the ruling by Judge Robison the directors of the Municipal Telephone Company held a meeting to discuss the status of affairs, but no definite action was taken. In legal circles the decision is regarded as a death blow to the municipal telephone idea in Evansville. An appeal is not likely as it is generally believed that Mayor Covert and others prominent in the scheme are heartily glad that the decision has afforded them an excuse to let go of one of the most unique schemes ever devised in this State.

*The Electrical World and Engineer, June 22, 1901.

Theoretical Determination of Power Curves.

We give below several communications having for their subject the article by Mr. W. J. Berry, which appeared in our issue of January 30:

I have before me your number of January 30, containing a paper by Mr. W. J. Berry, on the theoretical determination of power curves. I am much surprised to find that the writer of this paper did not know of any rigid mathematical demonstration of the fact that, with an impressed e.m.f. of sine-wave shape, the resultant power curve is a sine curve of double frequency. I think it might interest him and your readers to know another demonstration, which does not involve any knowledge of calculus.

Let T be the period,

$$f = \frac{1}{T} \text{ be the frequency.}$$

We can represent the e.m.f. by the curve

$$y = A \sin\left(2\pi \frac{x}{T}\right)$$

where x represents the time. The current is represented by

$$y' = A^1 \sin\left[2\pi \frac{x}{T} + \phi\right]$$

where ϕ, which may be positive or negative, represents the difference of phase. Then the power is

$$y'' = y\,y' = A\,A^1 \sin 2\pi \frac{x}{T} \sin\left(2\pi \frac{x}{T} + \phi\right)$$

Now, by using the well-known formula,

$$2 \sin p \sin q = \cos(p - q) - \cos(p + q),$$

we have

$$y'' = \frac{A\,A^1}{2} \cos\phi - \frac{A\,A^1}{2} \cos\left[4\pi \frac{x}{T} + \phi\right]$$

If we transform the equation to a parallel x-axis at the distance

$$K = \frac{A\,A^1}{2} \cos\phi,$$

$$y''' = y'' - K = -\frac{A\,A^1}{2} \cos\left(4\pi \frac{x}{T} + \phi\right)$$

$$= \frac{A\,A^1}{2} \sin\left[4 \frac{\pi x}{T} + \frac{\pi}{2} + \phi\right]$$

or

$$y''' = \frac{A\,A^1}{2} \sin\left[2\pi \frac{x}{\frac{T}{2}} + \frac{\pi}{2} + \phi\right]$$

which shows that the power curve is a sine curve, whose period is $\frac{T}{2}$ and frequency $2f$.—Q.E.D.

It may be noticed that this demonstration saves the consecutive differentiating and integrating of the same function, which process is somewhat new to me. Very truly yours,

MONTREAL, CANADA. V. R. HEFTLER.

In the ELECTRICAL WORLD AND ENGINEER for January 30, Mr. William J. Berry gives an interesting demonstration of the fact that alternating-current power is a simple harmonic quantity of twice the e.m.f. frequency. I give below a somewhat briefer proof of one step in his demonstration which may interest your readers. A somewhat different notation is used:

Let p, e, i be instantaneous and E, I maximum values; ω angular velocity, t time, ϕ a constant angle of phase difference.

Mr. Berry shows that we may write:

$$p = e\,i = E\,I \sin\omega t \sin(\omega t \pm \phi),$$

$$= E\,I\,[\sin^2 \omega t \cos\phi \pm \sin\omega t \cos\omega t \sin\phi],$$

$$= E\,I\,[\sin^2 \omega t \cos\phi \pm \tfrac{1}{2} \sin 2\omega t \sin\phi],$$

the second term in the binominal being a simple harmonic of double frequency. I should suggest that instead of the differentiation, integration and substitution for K, the constant of integration, we might treat the first term as follows:

$$\cos^2 \omega t - \sin^2 \omega t = \cos 2\omega t$$
$$\cos^2 \omega t + \sin^2 \omega t = 1$$
$$2 \sin^2 \omega t = 1 - \cos 2\omega t$$

whence

$$p = \frac{E\,I}{2} \cos\phi - \frac{E\,I}{2}\left[\cos 2\omega t \cos\phi \mp \sin 2\omega t \sin\phi\right]$$

$$= \frac{E\,I}{2} \cos\phi - \frac{E\,I}{2} \cos[2\omega t \pm \phi], \text{ or if we use } E\,I \text{ effective,}$$

$$= E\,I \cos\phi - E\,I \cos[2\omega t \pm \phi], \text{ a displaced sine wave}$$

of double frequency, in which the displacement is the average power as the sine wave part $E\,I \cos(2\omega t \pm \phi)$ averages zero. This gives the significance of K directly as the average power.

SCHENECTADY, N. Y. JOHN C. PARKER.

In the issue of the ELECTRICAL WORLD AND ENGINEER of January 30 I notice an article by William J. Berry on power curves. In it he states that "every alternating-current engineer knows that with an impressed harmonic e.m.f. of sine-wave shape the resultant power curve is a sine curve of double frequency; but so far as the present writer knows there exists no rigid mathematical demonstration of this fact." The matter is so simple that the proof of the proposition is generally not given in full. Every mathematician knows that the product of two sines is another of double the frequency, independent of the phase relation. Following is a solution with notes on this question:

Let	e	be the	instantaneous e.m.f.,
	i	" "	" current,
	p	" "	" power,
	E_m	" "	maximum e.m.f.,
	I_m	" "	" current,
	E	" "	effective e.m.f.,
	I	" "	" current,
	P	" "	average power,
	t	" "	time in seconds,
	f	" "	frequency,
and	ϕ	" "	angle of lag or lead.

We then have

$$p = e\,i = E_m \sin 2\pi f t \times I_m \sin(2\pi f t \pm \phi).$$

From formulæ for the value of the sine of the sum or difference of angles,

$$\sin(2\pi f t \pm \phi) = \sin 2\pi f t \cos\phi \pm \cos 2\pi f t \sin\phi,$$

$$\therefore \quad p = E_m I_m [\sin^2 2\pi f t \cos\phi \pm \sin 2\pi f t \cos 2\pi f t \sin\phi].$$

From formulæ for the functions of double and half arcs,

$2 \sin^2 2\pi f t = 1 - \cos 4\pi f t$, and $2 \sin 2\pi f t \cos 2\pi f t = \sin 4\pi f t$;

$$\therefore \quad p = \frac{E_m I_m}{2} [2 \sin^2 2\pi f t \cos\phi \pm 2 \sin 2\pi f t \cos 2\pi f t \sin\phi],$$

or $$p = \frac{E_m I_m}{2} [(1 - \cos 4\pi f t) \cos\phi \pm \sin 4\pi f t \sin\phi],$$

$$p = \frac{E_m I_m}{2} \cos\phi - \frac{E_m I_m}{2} [\cos 4\pi ft \cos\phi \mp \sin 4\pi ft \sin\phi],$$

$$p = \frac{E_m I_m}{2} \cos\phi - \frac{E_m I_m}{2} \cos(4\pi ft \pm \phi).$$

Now, $\frac{E_m I_m}{2} = EI$ and $P = EI \cos\phi$;

$$\therefore \quad p = P - EI \cos(4\pi ft \pm \phi) \quad \text{Eq. } (a)$$

Equation (a) can, of course, be rewritten.

$$P - p = EI \cos(4\pi ft \pm \phi),$$

$$\text{or} \quad P - p = EI \sin\left[\frac{\pi}{2} - (4\pi ft \pm \phi)\right]$$

This shows a curve of twice the frequency and symmetrical with respect to an axis, which is a distance P or the average power above the X axis of the e.m.f. and the current.

In Franklin and Williamson's "Alternating Currents," page 60, you will find the remark that

$$p = P - A \cos(2\omega t - \Theta),$$

which is identical with Eq. (a) by changing the symbols; also on page 62, Example 36, this question is given as an example showing that the authors do not consider it as involving any mathematical difficulty.

Steinmetz, on page 364 of his "Alternating-Current Phenomena," shows that

$$p = P\left(1 - \frac{\sin(2\beta - \omega)}{\cos\omega}\right)$$

where $\beta = 2\pi ft$ and $\omega = \phi$ of the above notation. This is also identical with Equation (a).

Burlington, Vt. W. H. Freedman.

The following is perhaps a more direct method of developing the power curve than that given by Mr. Berry in your issue of January 30.

Let the equations of instantaneous values of e.m.f. and current be, respectively,

$$e = E \sin\alpha \qquad (1)$$
$$i = I \sin(\alpha \pm \beta) \qquad (2)$$

where E is the maximum value of e.m.f., I the maximum value of current, α the angle of phase and β the angle of lag or lead (phase displacement).

The value of the power in the circuit is, at any instant,

$$w = ei = EI \sin\alpha \sin(\alpha \pm \beta)$$
$$= W \sin\alpha \sin(\alpha \pm \beta) \qquad (3)$$

Differentiating with respect to α,

$$D_\alpha w = W[\sin\alpha \cos(\alpha \pm \beta) + \cos\alpha \sin(\alpha \pm \beta)]$$

$$= W \sin(2\alpha \pm \beta) \qquad (4)$$

For a maximum, this is

$$W \sin(2\alpha \pm \beta) = 0$$
$$\text{or} \qquad \sin(2\alpha \pm \beta) = 0$$

and occurs when $2\alpha \pm \beta = n\pi$, where n is zero or a whole number. Hence, the value of α for a maximum value of ω is

$$\alpha = \frac{n\pi \mp \beta}{2} \qquad (5)$$

and occurs four times, while α varies from 0 to 2π.

Hence, the curve defined by (3) has double the periodicity of either (1) or (2).

From (4), we have

$$w = W \int \sin(2\alpha \pm \beta)\, d\alpha$$
$$= -\frac{W}{2} \cos(2\alpha \pm \beta) + C \qquad (6)$$

where C is the constant of integration. Transforming axes so that $w = 0$, $\alpha = 0$, we have

$$C = \frac{W}{2} \cos\beta$$

and from (6)

$$w = -\frac{W}{2} \cos(2\alpha \pm \beta) + \frac{W}{2} \cos\beta$$

$$= \frac{W}{2} [\cos\beta - \cos(2\alpha \pm \beta)] \qquad (7)$$

the equation of the power curve.

Now, substituting in (7) the values of α obtained in (5) we have

$$w_{max} = \frac{W}{2} \{\cos\beta - \cos[(n\pi \mp \beta) \pm \beta]\} \qquad (8)$$

For $\beta = 0°$ we have

$$w_{max} = W \text{ and } 0 \text{ (two values of each).}$$

For $\beta = 90°$ we have

$$w_{max} = \pm \frac{W}{2} \text{ (two values of each).}$$

That is, when current and e.m.f. are in phase, two values of the maximum vanish, and the two remaining values are both positive and equal to EI. The power curve then has the same periodicity as the e.m.f. and current curves, with both crests on the same side of the axis of time.

When current and e.m.f. are not in phase, but differ by an angle β, the power curve has double the periodicity of either, with alternate crests on opposite sides of the axis of time. When $\beta = 90°$ the areas of these two crests are equal and the integral of the curve, taken between $n\pi$ and $(n+1)\pi$ is zero— the condition of a wattless circuit.

New York. Bassett Jones, Jr.

I was much interested in the article in your issue of January 30 by Mr. William J. Berry, entitled, "The Theoretical Determination of Power Curves," as I had a few days previous to seeing it worked out a proof of the same law with which Mr. Berry deals. I obtain the same final equation, but in a slightly different and, to my mind, in a somewhat better manner, as follows:

I shall use the notation adopted by Mr. Berry and omit the first part of the demonstration as my work is the same as his up to the equation,

$$y'' = a' \sin^2 x \pm \frac{\beta'}{2} \sin 2x$$

From Wentworth's Trig. § 33. $\cos 2x = \cos^2 x - \sin^2 x$.

Substitute for $\cos^2 x$, $1 - \sin^2 x$, and we get $\sin^2 x = \frac{1 - \cos 2x}{2}$;

and thus

$$y'' = \frac{a'}{2} - \frac{a'}{2} \cos 2x \pm \frac{\beta'}{2} \sin 2x.$$

Putting for a' and β' their values, $AB\cos\phi$ and $AB\sin\phi$, respectively,

$$y'' = \frac{AB}{2} \cos\phi - \frac{AB}{2} (\cos 2x \cos\phi \mp \sin 2x \sin\phi),$$

$$\cos 2x \cos\phi \mp \sin 2x \sin\phi = \cos(2x \pm \phi).$$

Hence,

$$y'' = \frac{AB}{2}\cos\phi - \frac{AB}{2}\cos(2x \pm \phi)$$

$$= \frac{AB}{2}\cos\phi - \frac{AB}{2}\sin\left(\frac{\pi}{2} - \overline{2x \pm \phi}\right)$$

$\frac{AB}{2}\cos\phi$ is the constant of integration K used by Mr. Berry.

The effective values of y and y'' are $y_e = \frac{A}{\sqrt{2}}$ and $y'_e = \frac{B}{\sqrt{2}}$, and their vector product,

$$y_e y'_e \cos\phi = \frac{AB}{2}\cos\phi = K.$$

To prove that the axis, X', is the axis of symmetry of the curve $y\,y'$, it is necessary and sufficient to prove that K is the arithmetical mean of $y\,y'$. This mean is given by the area under one cycle of the curve divided by the base, or

$$\text{mean} = \frac{1}{180}\int_0^{180^\circ}(AB\sin^2 x\cos\phi \pm AB\sin x\cos x\sin\phi)\,dx,$$

since while x varies from 0 to 180°, $y\,y'$ goes through a complete cycle, being of double the frequency of the curves y and y',

$$\text{mean} = \frac{AB}{180}\left\{\cos\phi\int_0^{180^\circ}\sin^2 x\,dx \pm \sin\phi\int_0^{180^\circ}\sin x\cos x\,dx\right.$$

$$= \frac{AB}{180}\left[-\frac{1}{2}\cos\phi\,\cos x\sin x + \frac{x}{2}\cos\phi \pm \frac{1}{2}\sin^2 x\right]_0^{180^\circ}$$

When $x = 0$ all terms in brackets become zero, and when $x = 180$ all but the second vanish, giving for the mean,

$$\frac{AB}{180}\times\frac{180}{2}\cos\phi = \frac{AB}{2}\cos\phi = K.$$

The quantity $\frac{AB}{2}\cos\phi$, being the vector product of the effective values of the pressure and current waves, is obviously the power as measured by an ordinary wattmeter.

LOS ANGELES, CAL. FRANK R. STOWE.

The Uses of Natural Gas.

The most profitable customers that the natural gas companies have are the householders. The natural gas companies of to-day supplied 509,695 domestic consumers in 1902. So says Mr. F. H. Oliphant in his report on the "Production of Natural Gas in 1902, which has just been published by the United States Geological Survey as part of its annual volume on Mineral Resources. Natural gas, he states, is used on many other hearths than the purely domestic. Iron mills, steel works, glass works and various other establishments to the total number of 8,103 made use of its energies in 1902. The number of natural gas companies that supplied the 509,695 home bodies and the 8,103 establishments in 1902 was 2,147, which represented a gain of 602 companies over the enrollment of 1901.

One of the most effective uses to which natural gas has been put is as motive power for engines. The natural gas engine came into favor about ten years ago, when its use was first employed in pumping wells. Afterward, in forms of magnitude ranging from 5 to 500 hp, it was extensively introduced into manufacturing plants, where it has successfully demonstrated its economy and reliability. Owing to the large number of points that are often widely separated and are difficult to supply with other fuel, it is particularly applicable to the pumping of oil wells and to driving pipe line pumps.

Serious Subway Fire In New York City.

At ten minutes to nine on Wednesday morning, April 6, a remarkable accident occurred in the excavation for the rapid transit tunnel at the southwest corner of Broadway and Fulton Street, in New York City. To obtain the space necessary for the tunnel, the contractors have been obliged to rearrange all of the underground structures found in the path of their work. The task of doing this is plainly one of the first magnitude and has been rendered enormously difficult on account of the conditions imposed by public opinion, which required that the work should be carried on without interruption of street traffic. As a result of these conditions, the spectacle of gas pipes carried overhead along Broadway, New York, has been one of the many curiosities of the metropolis. Near this point, and in front of St. Paul's Church, is a shaft connecting between the tunnel and a temporary bridge extending across Broadway.

The disturbance which has been caused to the telephone, telegraph and electric light circuits in this subway excavation has been typical of that which has taken place along the entire route of the rapid transit tunnel, already nearing completion from the City Hall northward. From the location in trouble last week and running south to Wall Street, and some distance beyond, as well as running north to the City Hall and the Postal Building, at Murray Street, there extends the most complex and important wire network which exists

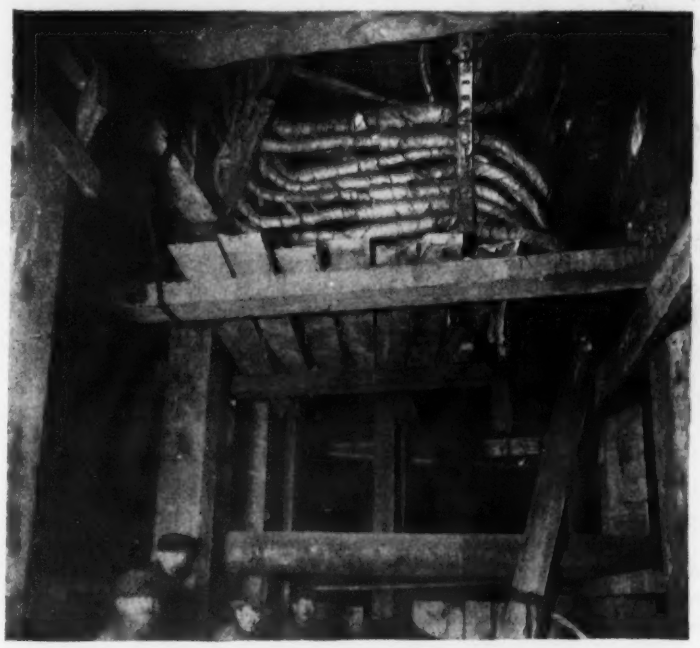


FIG. I.—CABLES AT SCENE OF THE FIRE.

in this or any other country. This, together with the ponderous gas and water mains and sewers, with their various lateral connections, constitutes a plexus of underground conductors unparalleled in their importance and intricacy. In the midst of this system, which is the spinal cord of the city's underground communications, there occurred the accident above referred to. It was simple in its nature and insignificant in the direct damage which it produced. Its indirect consequences were far-reaching and not only produced a paralysis of the local means of communication, but also suspended for the time being important lines of communication to all parts of the United States and Canada.

To make way for the subway structures the contractors had removed the usual protecting manhole provided by the Empire City Subway Company for the conductors running in its ducts and had massed the cable thus exposed in a tangle most inextricable in its nature. To protect these cables from damage by workmen, the contractor had wrapped them with burlap coverings and surrounded them with woodwork. One of the cables which had been damaged was being repaired by a telephone splicer, who, in the carrying out of his work, employed the usual pot of heated paraffine, melted lead and gasoline stove. On account of some circumstance, which will probably never be discovered, the paraffine took fire and flame was immediately communicated to the burlap about the cable and to the woodwork. The heat generated for the time being was intense. The

burlap took fire and melted off the lead covering of 22 large telephone cables, containing 5,250 pairs of wire, 8 Western Union cables carrying important telegraphic circuits, 5 Postal Telegraph cables carrying wires of equal importance, a burglar alarm cable of the Holmes Electric Protective Company, a cable of the American District Telegraph Company, a cable of the New York Stock Quotation Company, a cable of the Automatic Fire Alarm Company, a burglar alarm cable of the Mercantile Electric Company, a city fire alarm telegraph cable, a Gold & Stock Ticker cable, several circuits of the police telephone system and some other circuits of a miscellaneous nature.

The effect upon the telephone service was immediate and profound. The short-circuiting of these wires overloaded the ringing generators and storage batteries of the Cortlandt Street central office. This resulted in the operation of the circuit-breakers. By this means not only were the wires in the cables actually injured thrown out of service, but all of the wires centering at Cortlandt Street, coming in through cables from other directions, were rendered inoperative. In addition to this, a mass of trunk wires extending from the Broad,

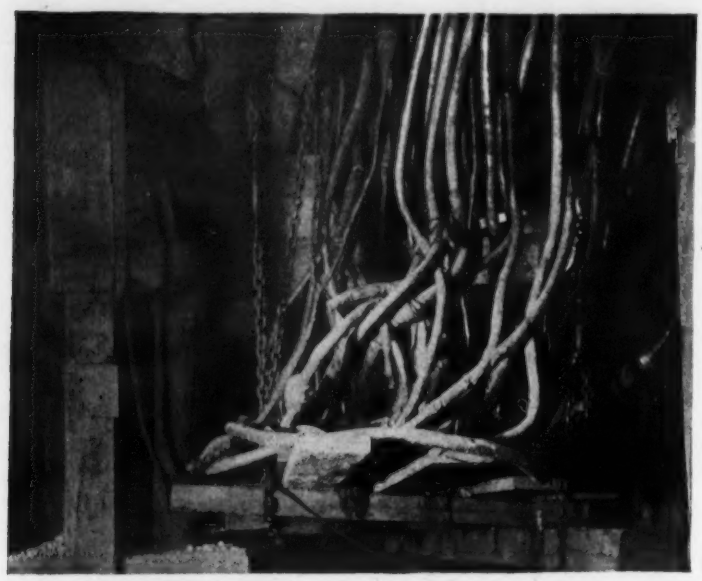


FIG. 2.—EXCAVATION AT ANN STREET, NEAR SCENE OF FIRE.

John and Cortlandt Street offices and going to points north were made useless.

At nine o'clock on the morning in question the Cortlandt Street office had been put entirely out of business. To do this it took just ten minutes. All of the other offices were intact, but communication between the three offices above mentioned was cut off to all points north and communication between these three offices themselves was also cut off. Included among these injured cables was one of the Pupin cables which had just been laid, to replace the overhead west side line so recently removed. The interruption of this cable cut off long-distance communication with points in the east, including New Haven, New London, Providence, Boston and other New England points. Important Buffalo and other up-State wires were also thrown out of service.

The confusion which this produced in the business community of New York can hardly be described. Mayor McClellan organized a set of special messengers, which he called his "pony express," but notwithstanding this he declared that the business of the city was practically suspended. Large commercial houses, newspaper offices and other large concerns tried in vain to find a substitute for the telephone. Some of them went temporarily out of business.

To meet this emergency the resources of the New York telephone Company were not found wanting. Available for work in this emergency there were the entire staff of the construction department, consisting of 800 men and the staff of the maintenance department, consisting of 1,000 men. This was a case, however, where mere numbers would not count. It was impossible to employ in the very limited area where the damage occurred more than twenty-five men at a time. Five minutes after the accident the machinery of the telephone company was at work to repair the damage. A plan of campaign was determined upon. Relays of picked men were provided, and within an hour and a half after the accident all of the long-distance wires in the Pupin cable were restored to service. By afternoon the damaged local wires began to operate and at nightfall 800 of the damaged trunk lines were in successful operation and 200 of the subscribers' lines were restored. By the morning of Thursday a still further increase in the number of wires was reported and by Thursday night the entire telephone system was again working as though the accident had never occurred.

To those who were permitted to pass the cordon of police, which was thrown about the scene, the results obtained seemed to be nothing short of marvelous. The various telegraph and other companies concerned were also represented in full force, so that by Friday the service of the companies concerned was proceeding normally.

While the occurrence of this accident was the cause of extraordinary inconvenience to the telephone company and to the public, and produced excitement rarely witnessed in down-town New York, it served one good purpose. It called attention to the inestimable value of the telephone service as exemplified in this city and served to bring to public attention in the most sensational manner the utter paralysis of business which would result were the entire telephonic and telegraphic system of this city suspended. Owing to the fact that Manhattan Island is divided into seventeen telephone districts, each with its own fire-proof central office and underground subway connections, a complete interruption of the telephone service could be brought about only by a catacylsm. The results produced by this temporary interruption of even one office has shown the wisdom of the engineering plans, which have provided that all of the eggs should not be placed in one basket, .i e., one big exchange. The conditions which obtained at the corner of Fulton Street and Broadway are by no means unique. They are merely typical of the snarl of telephone cables which has been produced at scores of places throughout Manhattan Island during the construction of the underground road. That the service has not heretofore noticeably suffered from these interruptions can only be interpreted as evidence of the extraordinary care manifested by those charged with the maintenance of the telephone service.

The General Electric-Allgemeine Electricitats Gesellschaft Combination.

A special meeting of the Allgemeine Electricitäts Gesellschaft was held at Berlin February 27, at which was submitted a report of the details of recent arrangements entered into by that company with the General Electric Company and several European electric manufacturing companies.

Referring to the amalgamation of the Allgemeine Electricitäts Gesellschaft with the Union Elektricitäts Gesellschaft, it was stated that the barriers have been removed, and now that the relations to the American company have been adapted to the new condition of affairs "this amalgamation seems to be the last conclusion in the joining of interests which were but a step in this direction." Referring to the journey of Managing Director Mr. Rathenau to the United States, one of the more important reasons is stated to have consisted in the settling of the future relations between the Allgemeine Electricitäts Gesellschaft and the General Electric Company. "The latter company is the most important representative of the electrical industries in that part of the world. The works of this company are of vast dimensions. It controls a large staff of able men from the scientific and practical engineering world; and it furthers with ample means and rare generosity the development of electrical industry both in laboratory and testing shops. A close relation to this firm seemed all the more desirable to the Allgemeine Electricitäts Gesellschaft by the alliance of the Union Electricitäts Gesellschaft with the Thomson-Houston Company, which has since been absorbed by the General Electric Company. The General Electric Company has various branch companies in Europe, i. e., England, France and the Mediterranean, which companies have retained the name of Thomson-Houston. In America the General Electric Company controls the Edison General Electric Company, the Thomson-Houston Electric Company, Fort Wayne Electric Works, Stanley Electric Manufacturing Company, Eddy Electric Corporation, General Incandescent Arc Light Company, Sprague Electric Company and the Northern Electric Company.

"The territory of the Union Electricitäts Gesellschaft comprised Germany, Central and Northern Europe and the Balkan States. With the aid of local capital they had founded the Austrian and Russian Union Electricitäts Gesellschaft and the Union Electrique

in Brussels. The various companies are confined to their geographical territories by agreements between these companies and the parent company, but they are at liberty to extend their field of operation by a special agreement. In this manner the Union Electricitäts Gesellschaft has, by an arrangement with the Mediterranean Thomson-Houston Company, acquired the right to carry on business in Italy, subject to certain conditions.

"The element which unites all the companies of this vast group is the interchange of patents and experience. Not only did we endeavor to join this concern and establish friendly relations with the European undertakings, but we were anxious to universalize the more important technical and commercial interests, which we possess in our steam turbine patents and those of Riedler-Stumpf. The combination of the latter with those of the Curtis group, which the General Electric Company had acquired for its own exploitation in the United States, and which it was about to utilize in other countries, seemed to us very useful, indeed. Our numerous agreements with the American and European companies contain the following chief points:

"1. An understanding by which the Allgemeine Electricitäts Gesellschaft and the General Electric Company define the territories of their own and their branch companies and each party leaves to the other the rights and experience for each individual territory. The exclusive territory of the General Electric Company comprises the United States of America and Canada; that of the Allgemeine Electricitäts Gesellschaft Germany, including Luxemburg, Austria-Hungary, Russia in Europe and in Asia, Finland, Holland, Belgium, Sweden, Norway, Denmark, Switzerland, Turkey and the Balkan States. With regard to the territories of the various branch companies in Europe, separate agreements have been made. For the other continents, including South America, a joint working of the two large concerns is proposed, an agreement which will no doubt result in a profitable joint undertaking. The present condition of affairs holds good in Spain and also in Greece.

"2. The General Electric Company and the Allgemeine Electricitäts Gesellschaft will form a company with a capital of three million marks for the exploitation of the Riedler-Stumpf and the Curtis steam turbine patents in the territory of the Allgemeine Electricitäts Gesellschaft. In this combination the Curtis patents are valued at 1.8 million marks and the Riedler-Stumpf patents at 1.2 million marks. The Allgemeine Electricitäts Gesellschaft has secured a license to supply all non-European countries with the exception of the United States and Canada. In these latter countries the General Electric Company has secured the Riedler-Stumpf rights.

"3. The rights for the use of the Curtis patents for marine engines had been secured by the International Curtis Marine Turbine Company. This company had given the license to the Allgemeine Electricitäts Gesellschaft for their European territory, while the Allgemeine Electricitäts Gesellschaft allowed the marine turbine company to use the Riedler-Stumpf patents for their marine work.

"4. For the purpose of working the steam turbine patents of Profs. Riedler and Stumpf, the Allgemeine Electricitäts Gesellschaft has formed a 'Company for the Introduction of Inventions, Limited.' The patents have now passed into the possession of the Vereinigte Dampfturbinen Gesellschaft and in the United States in the hands of the General Electric Company, the marine patents having been secured by the marine turbine companies and the inventors, Messrs. Riedler and Stumpf, derive part of the profits from the facilities granted to the Allgemeine Electricitäts Gesellschaft.

"5. A similar contract to that concluded with the General Electric Company has been made with the Thomson-Houston Company for the export trade. Various additional rights have been granted to the British Company, such as a financial participation in the branch companies of the Allgemeine Electricitäts Gesellschaft and of a company which may eventually be formed in Great Britain for the manufacture of Nernst lamps. The Allgemeine Electricitäts Gesellschaft reserves the right to also supply turbines in addition to the other manufactures.

"6. Similar to the relations with the British Company there also exists an exchange of patents and experience with the French Thomson-Houston Company. The Allgemeine Electricitäts Gesellschaft will restrict their French establishment to the sale of their manufactures in France and will supply engines and steam turbines to the French company only. This company has secured the option to draw shares of the Society Francaise d'Electricite Allgemeine Electricitäts Gesellschaft up to a certain amount. On the other hand, the French Thomson-Houston Company guarantees to the Allgemeine Electricitäts Gesellschaft a demand of dynamos in proportion with the turnover of apparatus up to the present time."

The report states that the various agreements give the right to form the following companies:

"1. A company for the manufacture of turbines, turbo-generators and accessory apparatus. The Allgemeine Dampfturbinen Gesellschaft is to be equipped with a share capital of five million marks, to be paid in as required. The shares are subscribed for by the Allgemeine Electricitäts Gesellschaft. For the establishment of a factory it is proposed to use the land, buildings and plant of the Union Electricitäts Gesellschaft, the working of which has been absorbed by the Allgemeine Electricitäts Gesellschaft. The above-mentioned real estate will be let to the Allgemeine Dampfturbinen Gcsellschaft for a number of years with the option of their purchasing it outright. The technical management will be in the hands of Director Lasche, who, up to the present, has been looking after the turbine construction work of the Allgemeine Electricitäts Gesellschaft.

"2. The above-mentioned Turbine License Company: This company has already been formed under the name of Vereinigte Dampfturbinen Gesellschaft M. B. H. (United Steam Turbine Company, Limited.)

"3. An Italian company with a capital of six million lire: This will be transferred to the organizations of the Allgemeine Electricitäts Gesellschaft and the Thomson-Houston Company, as well as the Italian turbine patents of the entire group.

"4. An arrangement somewhat similar to that existing between the Allgemeine Electricitäts Gesellschaft and the Union Electricitäts Gesellschaft has been arrived at between the Société Belge d'Electricité Allgemeine Electricitäts Gesellschaft and the Union Electrique in Brussels. A formal amalgamation of these two companies may take place in the future.

"Although the expense in connection with the companies enumerated, the purchase of patents and the sums advanced represent a considerable amount, this is still further increased by the taking over of the shares of the Austrian Union Electricitäts Gesellschaft in which the Berlin Union Electricitäts Gesellschaft is largely interested, and which for this reason and also for the purpose of establishing suitable works in Austria we wish to entirely reorganize.

"Finally the Allgemeine Electricitäts Gesellschaft will probably have to supplement and safeguard the working stock of the Union Electricitäts Gesellschaft, who obtained heretofore the greater part of their working material on a credit system, should they wish to follow the course of action which they have successfully carried out in financial matters during the past twenty years."

After giving details of the plans made for obtaining the necessary capital to carry out the programme detailed above, the report takes up the matter of the arrangements made with the firm of Brown, Boveri & Co. concerning which the following information is given:

"The firm of Brown, Boveri & Co. was formed in 1891 as a limited liability company for the manufacture of electrical apparatus and construction of electric central stations and equipping of railways. In consequence of their large share in the development of the electrical industry and the important contracts, the firm received the municipal power stations, etc., their works had to be enlarged from year to year. The investments in connection with this development led to the transformation of the limited liability company into a joint stock company. Messrs. C. E. L. Brown, W. Boveri, C. Baumann-Stockar and S. W. Brown-Sulzer, of the board of directors, were appointed managers. The works at Baden (Switzerland) employ 2,000 men. In order to increase their output in Germany the firm formed a branch company in Mannheim. The original limited liability company did excellent business from the very first, but their balance sheets have not been published. The balance of the joint stock company show that the decline of business which set in with the new century, while certainly reducing the receipts, has not affected the solid basis of the undertaking. The dividends were 16 per cent., 5 per cent. and 7 per cent., respectively, for the three years, and the dividend for the year ending March 13, 1904, is estimated at 9 per cent.

"The firm of Brown, Boveri have only on rare occasions taken over installations, limiting their field of operation to manufacture. Their foreign organization comprises a branch office in Cologne, Frankfort-on-Main, Metz and Brussels, small branch companies in Paris, Milan and Christiania, representatives in Berlin, Munich, Stuttgardt, Moscow, Madrid, Stockholm, Hartlepool and Melbourne. Prac-

tically at the same time as the formation of the joint stock company took place, the firm of Brown, Boveri & Co. took over the manufacture of steam turbines. Agreements with the company for the construction of Brown-Boveri-Parsons steam turbines, in which Messrs. Brown, Boveri & Co. are interested, enabled this firm to build Parsons turbines for Switzerland, Germany, France, Italy, Russia and Belgium. In order to supply turbines for marine purposes, the Turbinia German Parsons Marine Company was formed. With the exception of a few modifications regarding distribution of work and abolition of unnecessary competition, the company will continue to work independently as heretofore and under the same management.

Electric Automobile Delivery Wagons.

During the past week, under the auspices of the Automobile Club of America, as already noted in these pages, trials have been conducted, of the nature of an endurance test, of automobile delivery wagons for freight, express, etc. Seventeen vehicles started and of these fifteen were still "in the ring" when the contest closed on Saturday night. This is regarded as an excellent showing. We illustrate some of the electric types herewith. The data of the test are now being grouped and analyzed, as to the trips made around New York City, under the varying conditions, and the results are awaited with much interest.

In a paper read before the Automobile Club of America as a preliminary to these trials, Mr. Hiram Percy Maxim gave some most interesting data relating to electric automobiles. He considers that the electric automobile has arrived at what would seem to be a fixed and possibly final type. In all but the smaller pleasure vehicles it has two series motors independently connected each to one of the driving wheels. The storage battery is carried below the body between the axles and almost never inside a part of the body. As compared with the steam, gasoline and combination gasoline and electric automobiles, the electric system is practically the only motor system in general use in commercial wagon service. In New York City alone there are now approximately 300 electric wagons and trucks in service.

All wagons of 2,000-pounds capacity, which is the capacity generally used by department stores and for light express service, have to make about 30 miles per day, and the battery equipment of such a wagon should correspond to this service. The price of such a wagon with the usual type of department store body is about $2,500. A good battery will do 95 days work in such a wagon before it needs cleaning, which consists in cutting each connecting strap so that "mud" may be washed from the plates and from the jar. The cells are then reconnected, or "burned" together, and after being given a slow charge are again ready for service. After this cleaning they run about 75 days more before the mud has again accumulated to a point requiring another cleaning. After this second operation it is

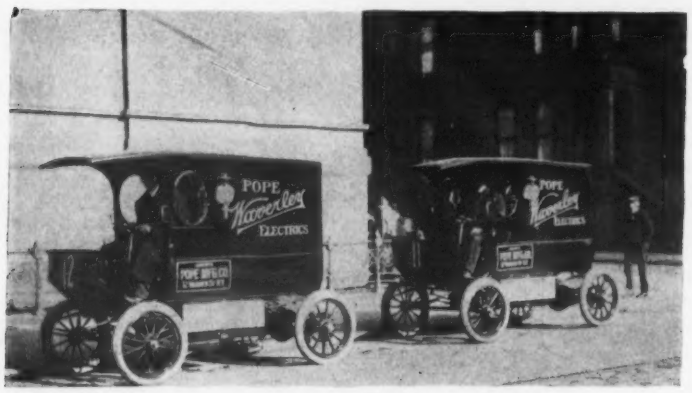


FIG. 1.—ELECTRIC DELIVERY WAGONS.

usually found that the wooden separators, if used, require to be replaced by new ones; this latter requirement involves the separation of plates when they are removed from the jar and means more labor and a greater breakage of separators and plates than at the first cleaning. When this has been done and the battery has gone into service for the third time, it is good for about 60 days more work before all of the active material on the positive plates has been shed and their useful life ended. When this point is reached a new set of positive plates is substituted and since this means the handling of fragile acid-soaked wood separators, these also must be replaced by new ones. The battery then starts out entirely fresh except for the negative plates. In most cases these hold out and show no signs of failure until the next cleaning and they do not appear to give out together as do the positives. An average might be set at one set of negative plates for every 1⅔ sets of positive plates.

Taking a full year's work, the cost per annum for a battery under the above conditions is about as follows: New positive plates,

FIG. 2.—ELECTRIC EXPRESS WAGON.

$155; new negative plates, $84; new wooden separators, $26.10; rubber separators, $4.55; rubber jars broken in service and handling, $21.70; total repair in connection with battery, $65; supplies and all other expenses, $43.50. Total, $404.85. On the basis of 30 miles per day and 288 full working days per year for such a wagon, this means 8,640 miles per year, which brings the battery maintenance expense to 4.68 cents per vehicle mile, or $1.40 per day.

As to rubber tires, on a 2,000-pound wagon, a 3½-in. tire is a generous one and the price of a set of such tires, allowing something for scrap, is about $188. In New York City such tires may be de-

FIG. 3.—ELECTRIC EXPRESS WAGON.

pended upon for about 9,000 miles service, which is equivalent to 2.09 cents per vehicle mile, or 62.7 cents per day.

For charging, the requirement is 14.2 kw-hours per day per vehicle. If this is taken from an isolated plant with which a stable or store may be equipped, the cost would never be above 2 cents per kw-hours, and when taken from the street mains it usually amounts to something nearer 4 cents. Assuming 3 cents, on a basis of 288 working days per year, the total consumption is 4,090 kw-hours, which at 3 cents is $122.70 per annum, or 1.42 cents per vehicle mile.

For the cost of general repairs it is stated that the annual charge will be about 4 cents of the price of the wagon, the batteries and tires being left out. In the modern type of wagon costing $2,500, the price less batteries and tires is $1,827; 4 per cent. of this is $73.10 per annum, or 85 cents per vehicle mile as the average for general repairs for this size of wagon. The depreciation may be taken at 10 per cent. on a price of the vehicle less the batteries and tires, which would amount to $182.70, or 2.12 cents per vehicle mile. Taking the interest on the investment at 8 per cent., this would be $125 per annum, or 1.45 cents per vehicle mile.

The various items are, therefore, as follows: Battery maintenance, $404.85; tire maintenance, $180; cost of charging current, $122.70; general repairs, $73.10; depreciation, $182.70; interest on investment, $125. This makes a total per annum of $1,088.35, or 12.61 cents per vehicle mile. This amounts to $3.78 per day, or if 250 packages per day are delivered, to 1.51 cents per package.

The paper next took up the cost of maintaining 3-ton and 5-ton trucks. By the means of an analysis similar to that which precedes, the annual cost of such a truck is found to be $1,609.77, or 23.2 cents per vehicle mile, or 11.6 cents per ton mile, or $5.57 per day. In a similar manner the cost of a 5-ton truck is found to be $1,760.85 per annum, or 30.57 cents per mile, or with the average load, 8.74 cents for every ton hauled a mile, or $6.11 per day.

The paper gives a lengthy discussion of the various items in the above totals. The conclusion is that the direction for the future motor lies in reducing the cost due to the battery, tires and depreciation.

As to the battery factor, it is stated that two new automobile batteries are at present being weighed in the balance, one of these being that of Mr. Edison, and the other a Planté type. The latter is an old battery conventional in form, but owing to its construction its active material sheds less rapidly than in the pasted type, the plates consequently lasting longer. It is stated that this battery has a most creditable record to date.

As to the Edison battery, it is claimed by the manufacturers that the plates never need renewing in the sense in which that term is considered in the paper. The Adams Express Company has for four months been operating with this battery four of its delivery wagons, and at the present time the manufacturers' claims have been equalled. While a much longer experience will be required to determine the value of this battery, it is theoretically directed in the proper line of improvement and, therefore, worthy of most careful consideration. It suffers, however, from its higher cost and the large amount of charging energy which is lost in recharging. The 2,000-pound wagon which now sells for $2,500 would cost $3,005 with this battery, while the saving in weight is only 375 pounds, and the battery requires 60 per cent. more energy than is required in

FIG. 4.—ELECTRIC TRUCK.

charging lead batteries. In the case of the 2,000-pound wagon this means $204 per annum, instead of $122.70 with the lead battery. It would seem fair to expect more repairs with the Edison battery. An analysis of the different items show, however, a net gain per ton mile for the Edison battery amounting to quite a considerable amount, being 13 per cent. in the 2,000-pound wagon, 12 per cent. in the 3-ton wagon, and 12½ per cent. in the 5-ton truck.

The Planté battery above referred to, which is known as the Manchester "box" type, has a strictly Planté positive plate and what is called a "box" negative plate, and is stated to be unquestionably the longest-lived and most rugged storage battery in existence. The cost of maintenance of this battery is discussed and the calculation shows a net gain practically identical with that of the Edison battery. For instance, in the 2,000-pound wagon it will cost for maintenance 10.93 cents per vehicle mile.

The rubber tire is stated to meet every practical requirement of

FIG. 5.—ELECTRIC DELIVERY WAGON.

automobile traction. The iron tire, while by no means impracticable, does not enable a motor vehicle to give its best performance. Experiments with hard wood tires in segmental blocks and with grain end on have been tried with satisfactory results except during the winter season, when they slip on ice and snow, although very much less so than iron tires. They are long-lived, semi-yielding, semi-noiseless, have very good wearing qualities, give good steering way, even taking car tracks at very close angles and are very cheap. Mr. Maxim considers that while not possessing all the necessary qualifications of a truck tire, they may yet be looked to as indicating the direction in which development should proceed.

The paper also contains a discussion of the maintenance charges of a gasoline vehicle. In the case of a vehicle corresponding to the 2,000-pound electric vehicle, the cost is found to be 9.12 cents per vehicle mile, as compared with 12.61 cents for the corresponding electrical vehicle, or with 11 cents if compared with the Edison battery, or with 10.93 cents if compared with the Manchester "box" battery. For a 3-ton vehicle the cost is 16.1 cents per vehicle mile as against 23.26 cents per vehicle mile for the electric vehicle, 20.47 cents for the vehicle equipped with the Edison battery, or 20.36 cents if equipped with the Manchester "box" battery. In the case of the 5-ton vehicle, the figures are 21.8 cents per vehicle mile, as compared with 30.57 cents for the electrical vehicle, 26.75 cents for the same equipped with the Edison battery, or 26.55 cents if equipped with the Manchester "box" battery.

In conclusion Mr. Maxim said that aside from the inherent peculiarities of the gasoline system which prevent it entering the field at present monopolized by the electric system, there would seem to be good reasons for believing that it will be cheaper at least than the best that we have in sight for the electric. It opens up at once the great field of suburban freight transportation which the electric cannot hope to enter, and which is already calling loudly for some kind of a motor vehicle. Mr. Maxim considers that the time has arrived when we may expect to see the gasoline commercial wagon and truck emerge from the gasoline touring car, just as the electric commercial wagon and truck emerged from the electric phaeton and brougham. As to the steam and combination systems, it is difficult to consider them other than as temporary expedients to be used only until the gasoline system takes final hold.

Washington Meeting American Electrochemical Society.

The meeting of the American Electrochemical Society, held on April 7, 8 and 9, in Washington, D. C., was in its social features perhaps the most enjoyable meeting held by the Society. All the papers presented were interesting and some of them were exceptionally so. The attendance, however, which had been expected to reach a very high figure, did not meet expectations, the number of members and guests registered being somewhat below a hundred. This seems to emphasize what has been pointed out before in this journal, that a national engineering society which holds two general meetings a year, holds one too many.

The very great interest shown in the Society was emphasized by the fact that 50 per cent. of the total membership cast votes for new officers. The results of the election were announced in the Saturday meeting, and were as follows: President, Prof. Henry S. Carhart, Ann Arbor, Mich.; vice-presidents, Mr. C. J. Reed, Philadelphia, Pa.; Mr. E. G. Acheson, Niagara Falls, N. Y., and Prof. C. F. Burgess, Madison, Wis.; managers, Dr. W. H. Walker, Boston, Mass.; Mr. C. E. Acker, Niagara Falls, N. Y., and Mr. Edward Weston, Newark, N. J. Mr. P. G. Salom was re-elected treasurer and Mr. S. S. Sadtler was elected secretary. Prof. Burgess was elected both vice-president and manager, and accepted the former office.

From the report of the secretary it appears that 196 new members were elected last year. The total number of members has now passed the 700 mark. From the report of the treasurer, which was read by Mr. Reed, in the absence of Mr. Salom, it appears that the surplus of the Society at present amounts to $1,652.52. In addition the Society holds $250 for the Frenzel prize, which has not yet been competed for.

As already stated, the social features of the meeting were extremely enjoyable, thanks to the excellent programme arranged by the local committee, with Col. Samuel Reber, U.S.A., as chairman and Mr. Clinton Paul Townsend as secretary. First in importance was the cordial reception of the members of the Society by President Roosevelt at the White House on Thursday noon. On the afternoon of the same day a complimentary excursion on a special "Seeing Washington" trolley car to all parts of the city was much enjoyed, since the weather was good and the parks of Washington presented themselves in the glory of spring. On the evening of the same day a "smoker" was greatly enjoyed, while on the evening of Friday a subscription banquet was held at the Shoreham. Dr. Wiley was a most humorous toastmaster, while Dr. J. W. Richards, Prof. H. S. Carhart, Col. Reber, Mr. C. J. Reed and Dr. Needham made speeches.

PROF. H. S. CARHART,
PRESIDENT AMERICAN ELECTROCHEMICAL SOCIETY.

On the afternoon of Friday a visit was made to the Navy Yard, where the visitors were enabled to see a shrinking of the jacket on one of the largest modern guns. The National Bureau of Standards was also open for inspection on Friday and Saturday. On the afternoon of Saturday visits were made by different parties to the Bureau of Chemistry, the Bureau of Engraving and Printing and an excursion, either by trolley or boat, to Mount Vernon.

In the business meeting on Thursday the amendment to the constitution, according to which the president, vice-presidents and managers shall, after the expiration of the full term of office to which they were elected, be ineligible for immediate re-election, was carried unanimously. It was also announced that the board of directors has decided to hold the next meeting during the week of the International Electrical Congress in St. Louis in September.

Following is a report of the papers presented at the meeting and of the discussion which followed the reading of papers:

STANDARD CELLS.

A paper on this subject was read by Dr. F. A. Wolff, of the National Bureau of Standards. In view of the fact that the advisability of an international agreement concerning the fundamental electrical units will be discussed in St. Louis at the International Electrical Congress this autumn, the author gave a review of the main points which are to be taken into consideration in connection with this question. Of the three units—ohm, ampere and volt—only two should be defined; the third one, then, follows from the two others by means of Ohm's law. Of these three units, the ohm is already exceedingly well defined and its definition can be easily made perfect by slight modifications. The ohm should, therefore, surely be chosen as one of the two fundamental units to be defined; the question is thus whether for the second unit the ampere or the volt is to be selected.

The author discussed the comparative advantages and disadvantages of defining either the ampere or the volt. A high accuracy can be obtained in both cases, but if the volt is defined in terms of the e.m.f. of a standard cell, one obtains certain distinct advantages which are not obtained when selecting the ampere as a fundamental unit. As standard cells, both the Clark and cadmium cells show a good constancy and accuracy, but the latter has the enormous practical advantage of a low temperature coefficient. The hysteresis, due to temperature variations in the Clark cell, may cause considerable mistakes in practice which are, of course, absent in the Weston cell. Moreover, the mortality of the Clark cell is quite high on account of its construction, and a layer of gas may be formed and interrupt the circuit. This is not the case in the Weston cell. For these reasons the author is sure that the Weston will replace the Clark cell.

The author then discussed the various methods of the preparation of the materials and described especially a new method of preparing mercurous sulphate in a uniform and well-defined state. It will be remembered that this is most important because the German Reichsanstalt and the British National Laboratory have found that lack of uniformity of the mercurous sulphate was the principal reason in the variation in the results so far obtained with standard cells. Dr. Wolff's method of preparing the mercurous sulphate is an electrolytic one. He uses a mercury anode and a mercury cathode with an electrolyte of sulphuric acid. The grain structure of electrolytic mercurous sulphate is such that there is no probability that it may influence the e.m.f. The author finally thinks that a Weston cadmium cell with saturated solution should be used for establishing the second unit. The unsaturated type of the Weston cell is also very good and its temperature coefficient is absolutely zero. The apparatus for the elec trolytic preparation of the mercurous sulphate was exhibited.

PREPARATION OF MATERIALS FOR STANDARD CELLS AND THEIR CONSTRUCTION.

A paper on this subject by Prof. H. S. Carhart and Dr. George A. Hulett was then read by Prof. Carhart. The authors first discussed the preparation of mercury, cadmium sulphate, cadmium amalgam and then dealt at length with the production of mercurous sulphate and it is very interesting to note that the method developed by the authors is in all essential points identical with that worked out independently by Dr. Wolff. Their method for securing Hg_2SO_4 free from nitrate was described as follows:

In a flat-bottomed beaker or deep crystallizing dish is placed mercury a centimeter or so deep. This is covered with dilute sulphuric acid (one to six) to the depth of some 10 cm. A platinum wire, protected except at its end by a glass tube, makes contact with the mercury, which serves as the anode; the cathode is a sheet platinum in the H_2SO_4 solution. A current of about 0.3 amp. is passed from the mercury into the solution; crystalline mercurous sulphate at once begins to separate on the surface of the mercury. A stirrer, consisting of a glass rod bent at right angles at the bottom, must be used to keep the mercury surface exposed. The foot of the stirrer passes close to the mercury and must be driven rapidly by a motor.

About 2.8 grams an hour can be prepared in this way. The sulphate should be protected from the light. By means of a separating funnel the excess of mercury may be readily removed from below, leaving the sulphate with more or less finely divided mercury mixed with it. The authors strongly recommend their method as a standard preparation of mercurous sulphate. It gives a lower e.m.f. with mercury than any preparation obtained from $HgNO_2$ and H_2SO_4

or a sulphate. Samples made at different times and with different materials show an extremely close agreement.

The authors have also built cadmium cells in which their electrolytic mercurous sulphate was used and have obtained excellent results from the same. The construction of the cadmium cells is described as follows: Fig. 1 shows the cell ready to be filled. The tubing is drawn out and contracted at *a* so as to leave the diameter about 6 mm., and with thin walls at this point. Fragments of the cadmium amalgam may be introduced into the clean, dry cell, and may then be melted by dipping the leg of the cell into hot water; or the amalgam may be melted under cadmium sulphate solution, and may then be introduced in liquid form by means of a small tube, slightly contracted at the end, and of a diameter that will allow it to pass freely through the neck, *a*. This tube is used as a pipette, and permits the melted amalgam to be introduced rapidly and without splashing. The mercury, the thin paste and the concentrated cadmium sulphate solution may be introduced in the same manner. An alternative method is to introduce the materials through little funnels made out of small test tubes. The funnels must pass through the neck, *a*, of the cell and must reach well down toward the bottom.

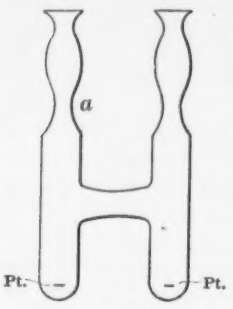


FIG. 1.—DIAGRAM OF CADMIUM CELL.

The electrolytic mercurous sulphate, which has stood with mercury under dilute sulphuric acid, is brought into a Gooch crucible, avoiding free mercury, which interferes with the filtering; it is then washed first with sulphuric acid (made by adding 0.5 c. c. concentrated H_2SO_4, density 1.84, to a liter of water), and then with concentrated cadmium sulphate solution. It is better to reject the top layer, which may be slightly darkened. The paste is next made in a clean agate mortar by grinding together crystals of $CdSO_4$ $8/3H_2O$, and a little mercury, and then mixing in about three volumes of the mercurous sulphate and enough saturated cadmium sulphate solution to make a thin paste. After the mercury and the paste have been introduced into the positive side of the cell, both legs are filled up to the cross tube with the dry, clean crystals of $CdSO_4$ $8/3H_2O$. Enough of the saturated cadmium sulphate solution is finally added to fill the cell to the top of the cross tube.

The sealing off is readily done by means of two small horizontal blast flames, 3 cm. long, directed in a line towards each other and just meeting. The narrow part, *a*, of the cell is brought between the impinging flames, the glass quickly softens, and the top part is drawn off. There is no noticeable heating of the contents of the cell, but it may be advisable before one has acquired the proper skill, to protect the cell by an asbestos disc fitted to the tube below the point, *a*.

One of the special features of these new types of cells is that they do not require any ageing process to reach their equilibrium in e.m.f. The cells reach their equilibrium immediately. This fact, together with the lower value of the e.m.f., compared with that of cells made by the use of mercurous sulphate prepared in any other way, points to the purity of the electrolytic salt, compared especially with that made from the nitrate of mercury.

In the discussion Mr. H. N. Potter urged that the glass from which the containing vessel is to be made should be exactly defined. Glass has, in general, no well-defined composition. Since now pure silicon can be produced cheaply (by the electric furnace process of Tone) we could use it. Dr. Wolff then stated that he had not yet set up cells with the electrolytic sulphurous sulphate, but from its crystalline character and purity he considered it specially suitable for standard cells. Prof. Carhart recommended that if the cadmium cell is adopted as a standard of e.m.f., we should distinguish between the "Weston cell, primary standard" (with saturated solution) from the unsaturated type, which we should call the "Weston cell, secondary standard." Mr. Carl Hering asked whether there was not an uncertainty introduced by hermetically sealing the cell. Prof. Carhart replied that the uniformity of the figures obtained in the tests was so excellent that the hermetical sealing process, which is done at about 20° C., apparently does not introduce any disturbing effect.

SINGLE POTENTIALS OF HALOGEN ELEMENTS.

A paper on this subject was then read by Mr. William Roy Mott. He began with an attack on the ionization theory and considered the solution tensions, assigned to metals by this theory, as impossible. He gives the following single potentials for dilute aqueous solutions: Chlorine, -2 volts; iodine, -0.87 volt; bromine, -1.53 volts; fluorine, -2.53 volts. In a table he gave the voltages of decomposition of various chlorides, fluorides, bromides and iodides in such a form that the well-known additive law is clearly exhibited. This became still more evident by plotting the results in form of a diagram in which equal increments mark the displacement of one metal by another metal or of one halogen element by another halogen element; this results in two sets of parallel lines. This diagram can be used in the calculation of any one of the three factors—the total decomposition voltage, the single potential of the anion and the single potential of the cation, when the other two factors are known. The additive law holds much better for dilute aqueous solutions than for solid salts. Solid salts may, in different forms, possess very different amounts of energy; for example, amorphous silver iodide has a heat of formation of 8.6 large calories, while the crystalline variety has a heat of formation of 14.2 large calories. This introduces a difference of 0.33 volt in their respective decomposition voltages. The author finally expresses the opinion that his results add force to the law that solubility is largely determined by the mutual affinity of the solvent and solute as represented by the heat of solution.

In the discussion which followed Dr. R. Gahl defended briefly the dissociation theory against the attacks of the author and claimed that the author's calculations of the absolute values of single potentials was in disagreement with the principles of thermodynamics.

THE CONTINUOUS ADVANCE OF ELECTROCHEMISTRY.

Dr. J. W. Richards' presidential address, which was delivered at a special meeting on Thursday night, dealt with the above subject, which was discussed under three headings. The author first dealt with the investigation and classification of electrochemical phenomena. He showed what an enormous work has been done in the past in the field of electrochemistry, but thinks that, in spite of the important results obained, even more could have been accomplished by true co-ordination and co-operation. National societies, like the American Electrochemical Society, are operative in bringing workers in different fields together. The author gave a list of such subjects which need further investigation.

The second point discussed by Dr. Richards was the building of a comprehensive electrochemical theory. He thinks that we are now passing through a transition state. He expresses as his own conception of the state of solution that the solute is in an abnormal physical state having resemblance to the gaseous state, and that in some cases a definite compound of the solvent and the solute exists in the solution, it also being in an abnormal physical state, but not abnormal chemically. From J. J. Thomson's recent theoretical investigations of the structure of the atom as a compound of electrons, we might conclude that the dissociation theory will be replaced by the electronic theory.

The third part of his paper dealt with the application of electrochemistry to industrial needs. The author gave a review of what has already been accomplished and spoke at some length on the recent process of Tone for producing silicon in the electric furnace. In concluding he said: If in the battle of industrial competition you are summoned by the conservatives of the industry to strike your colors, answer with the courage and determination of the intrepid Capt. John Paul Jones: "Surrender, sir? We have only begun to fight."

THE COMPOSITION AND RESOLUTION OF VOLTAGES.

The first paper read at Friday's session was by Dr. J. W. Richards on the above subject. It was essentially an enlargement of a former paper presented by the author to the Philadelphia Section of the Society and abstracted in these columns in the issue of February 13, 1904, page 323. The author now gave various numerical examples. For the composition of voltages at the anode, he gave the calculations for the solution of impure copper as it takes place in copper refining, and the solution of a copper-nickel alloy which is one of the steps of the Browne process. As examples of the resolution of voltages at the cathode he discussed the decomposition of a copper-silver alloy on the cathode and the deposition of a metal on the cathode with simultaneous liberation of hydrogen.

In the discussion which followed, Mr. Mott thought that various points might change this method of calculation; for instance, the heat of alloying is not taken into account, nor the overvoltage, etc. Mr. Hering thought that Dr. Richards' calculation is based too much on theoretical considerations, and Dr. Gahl thought that a method

of calculation on the basis of the ionization theory would give different results. On the other hand, Mr. Lawrence Addicks and Mr. C. J. Reed stated that the results of Dr. Richards' calculations were in agreement with those actually observed in practice and Dr. Richards also stated that measurements made by him had been found in agreement with his theory.

MOLECULAR CONDUCTIVITY.

A paper on this subject was presented by Mr. C. J. Reed, who pointed out that electrical conductivity is a property of matter, which can be measured only by employing a unit in which there is a definite section, across which the flux is measured, and a definite length in the direction of the flux. Mr. Reed claimed that this is not sufficiently taken into consideration by electrochemists. He compared the ordinary method of electrochemists for measuring molecular conductivities with the case that somebody might measure the conductance of a certain cube of silver between opposite faces, then fuse the silver with n times its volume of lead and measure the conductance of the resulting alloy between faces having n times the area of the original faces, and would then conclude from this that the conductance so measured represents the molecular conductivities of the silver in the two conditions of concentrations. It is wrong to assume that in an aqueous solution of a salt only the salt is a conductor for the electric current. The author claimed that there exists a certain confusion in books and papers on the dissociation theory, due to a lack of distinction between conductivity and molecular conductivity. He concludes that the term molecular conductivity and all theoretical deductions based on investigations of molecular conductivities of different degrees of dilution have no physical significance.

In the discussion which followed, Dr. E. F. Roeber endeavored to show at some length that the term molecular conductivity follows as a consequence from the ionic hypothesis of the electrolytic conductivity of dilute aqueous solutions, and that there is no confusion whatever on this point in the electrolytic dissociation theory. Messrs. Hering, Gahl, Richards and Reber also participated in the discussion. Mr. Reed claimed that Roeber's definition of molecular conductivity is different from that ordinarily used in text-books.

ECONOMIC BALANCE IN AN ELECTROLYTIC COPPER REFINERY.

A paper on this subject was read by Mr. Lawrence Addicks, of the Raritan Copper Works. The author pointed out the close independence of the relations between various factors which form the economic balance in an electrolytic copper refinery. He separated the problem into three variables—tank resistance, age of electrodes and current density. Tank resistance is made up of metallic conductors, contacts, anode slimes, counter e.m.f. due to concentration changes, electrolyte, and a negative quantity due to imperfect efficiency. He discussed these various factors in detail. Concerning the temperature coefficient, he remarked that it is large, and that it is necessary to strike a balance between power saving, cost of heating, increased contact losses and increased cost of keeping the copper contents of the electrolyte down to the required figure. Concerning the question of age of electrodes, much depends upon whether or not the refiner is charged with interest on the metals tied up in the process. Finally, from the standpoint of current density the problem becomes largely one of output. In the light of this multiplicity of relations, it is easy to see why no two refineries use just the same current densities, temperatures, etc. A difference in the cost of labor or power or supplies would tip the economic balance to a new reading at once. Finally, the lowest cost per ton may not be the cheapest cost per ton. This apparent paradox is due to the fact that with a current density somewhat greater than that giving the lowest cost per ton, the output may be sufficiently increased to give greater earnings in spite of the higher cost per unit.

In a communicated discussion, Prof. Bancroft claimed that Mr. Addicks had not given an adequate discussion of the conditions as they exist. Mr. Addicks replied to this criticism and remarked that the final economic balance is the summation of a large number of balances.

HEAT OF NEUTRALIZATION.

The next paper read was that of Mr. G. M. Westman on the theory of the heat of neutralization given by Dr. J. W. Richards to the Society last year. The author offers various theoretical objections to Richards' theory and also objects to the assumption that ionization is in no sense to be regarded as a re-solution or a decomposition of the molecules of the constituents. When more water is added to the solution, the molecules expand further and their constituents are further removed from each other. In the discussion which followed, Prof. Carhart remarked that the author's considerations were entirely hypothetical and Dr. Richards stated that the last statement of the author is in agreement with his own view that the dissolved state is similar to the gaseous state.

THE ENERGY OF IONS.

Dr. L. A. Parsons' (University of Utah) paper on this subject was then presented and, in the absence of the author, was read by Mr. S. S. Sadtler. The author discussed at length the objections which had formerly been raised by Mr. Reed against the dissociation theory from the standpoint of the principle of the conservation of energy. He endeavored to show that the views of the dissociation theory are fully in agreement with the energy principle. He also developed some conclusions from the electronic theory of ions.

In the discussion which followed, Mr. Reed thought that the theory developed was that of Dr. Parsons and not the dissociation theory; he also repeated some of his former arguments. The discussion was also participated in by Messrs. Cabot, Richards and Roeber, who defended the dissociation theory, and Gahl, who thought that some apparent difficulties would disappear if one would consider the ionic theory in the light of the electron theory.

ELECTROLYTIC CONDENSER.

A paper by Mr. C. I. Zimmerman was then read in the absence of the author by Mr. A. B. Marvin. The well-known property of the aluminum electrode of permitting the current to pass only in one direction, but not in the other, has already been made use of to construct an electrolytic rectifier, which consists essentially of a combination of an aluminum electrode with an iron electrode. The author has now made use of the same property for devising an electrolytic condenser, which is essentially a combination of two aluminum electrodes. Such an electrolytic condenser is cheaper than other condensers. It shows some leakage, but may be operated continually with an efficiency of 95 per cent. at 110 volts.

Saturday's session was opened with a discussion of Mr. Zimmerman's paper. Mr. Mott gave some additional data on the formation of an oxide film on aluminum. Mr. E. E. F. Creighton remarked that the dielectric strength of the oxide film is so enormously greater than other solid dielectrics that one might suppose the existence of gases in the film. Dr. Karl Guthe confirmed this view and stated that he had found experimentally that gas is contained in the film. Mr. Mott stated that the leakage current is not very large at low voltages in certain electrolytes, like phosphate, etc., but if one approaches the critical voltage, the leakage current becomes large. He has found the dielectric constant of the oxide film to be about 10. Dr. Gahl remarked that in experiments with aluminum electrolytic condensers he had been unable to get constant results.

A STUDY OF THE ELECTRIC ARC.

A paper on this subject was presented by Dr. William S. Weedon, of the General Electric Company. The author gave a great many highly interesting details, but stated frankly that it is still too early to give a complete theory of the electric arc. He only used direct-current arcs. Details were given on the copper arc in air, the copper arc in hydrogen, the iron arc in hydrogen and the carbon arc in hydrogen. It seems that oxidation or combination with the surrounding gas, is not absolutely necessary for the production of a luminous arc, but such a combination facilitates its formation. With regard to the amount of material fed to the arc, there is apparently the tendency for the arc to ionize the surrounding atmosphere if there is not enough material vaporized from the electrode. If much heat is developed, more is vaporized than is employed in transporting the current. Between these two extremes both the atmosphere and the electrode vapor are ionized.

There is a slow gradation from the spark discharges to the true arc, passing through the intermediate stage where both kinds of discharge are present. The main distinction, therefore, between the arc and the spark discharge is that in the former vaporized material from the electrode or electrodes undergoes most of the ionization which takes place, while in the latter the surrounding atmosphere suffers most of the ionization.

The structure of metallic arcs in air are in general as follows: The middle path is not luminous, but the light is derived from the outer mantle and most frequently from that portion of the outer

mantle next the inner path. In the carbon arc the outer mantle is not well defined, owing to the fact that the product of combustion is gaseous. It seems probable that the inner non-luminous path is in a way comparable to the Crookes dark space.

From a number of experiments on metallic arcs it seemed probable that the cathode determines the character of the arc, but there are other facts which distinctly contradict such a general statement. The author gave some hypothetical conceptions on the electronic theory of the phenomena in the arc. The paper was discussed by Messrs. Creighton, Browne, Hering and Richards.

COPPER VOLTAMETER.

Some phenomena observed in connection with the use of a copper voltameter were described in a paper of Dr. Isaac Adams and Mr. Barry MacNutt. The paper was read by Mr. MacNutt. The authors had made a determination of the intensity of the horizontal component of the earth field by means of the tangent galvanometer in connection with a copper voltameter. The main points observed were peculiar irregularities in the current when the reversals took place through the galvanometer, and the authors conclude that the reversals should not be made too often, not oftener than, say, every five minutes. Allowance must also be made for the re-solution for the deposited copper. If these precautions are taken, the copper voltameter is suitable for such measurements. In the discussion Mr. Carl Hering remarked that in measurements requiring such an accuracy, the copper voltameter should not be used at all. Mr. MacNutt replied that the consistent results obtained show that the copper voltameter is reliable if only the proper precautions are taken.

ELECTROLYTIC IRON.

A very interesting paper by Prof. C. F. Burgess and Mr. Carl Hambüchen was then read by Prof. Richards. The object of their investigation was to produce, if possible, pure iron in such quantities and at such cost as to make it a valuable material for further inquiry into its properties. They used an electrolyte consisting of ferrous and ammonium sulphates. The current density at the cathode was 5 to 10 amp. per sq. ft. of cathode surface and at the anode slightly less. The e.m.f. for each cell was slightly under one volt, the temperature of the electrolyte being about 30° C. The anodes consisted of ordinary grades of wrought iron and steel, while the starting sheets for the cathodes were of thin sheet iron previously cleaned of rust.

The current efficiency of decomposition was very closely 100 per cent.; that is, there is a deposition of about 1 gram per amp.-hour. The e.m.f. being 1 volt, gives about 2.2 pounds of iron per kw-hour. Although their work was directed toward the production of electrolytic iron in a tense and massive condition rather than in a high degree of purity, analyses which were made showed the purity to be in excess of 99.9 per cent. Not a trace of carbon was detected, and silicon and manganese and other impurities commonly found in iron appeared to be absent. The only impurity which was detected was hydrogen, which was present in appreciable quantities in the metal as taken from the electrolytic tanks. Hydrogen can be driven off, however, almost completely, if not entirely, by heating to a white heat, the evolution commencing at a temperature below 100° C. and becoming rapid at a temperature below a red heat.

The metal containing the hydrogen is so hard that it can be filed or sawed only with difficulty and it is so brittle that it is readily shattered by a sharp blow from a hammer. After the expulsion of the gas it becomes softer and after having been raised to a welding temperature it assumes properties of malleability and toughness similar to those of Swedish iron. The coefficient of hysteresis, the permeability and the electric resistance of electrolytic iron are greatly influenced by the amount of hydrogen in it.

Such electrolytic iron should be useful as a basis for investigating the properties of iron and its alloys. Electrolytic iron also naturally offers a means of manufacturing chemically pure iron compounds and for standardizing solutions in the analytical laboratory. Unless the difficulties encountered in the working of electrolytic iron on account of its roughness offer too serious an objection, it should compete favorably with the purer grades of commercial iron, which are used for various purposes, and which sell for 3 cents and upwards per pound.

In the discussion Mr. Woolsey McA. Johnson remarked that he had made similar experiments, using an electrolyte of ferrous sulphate with an addition of organic acid. He also suggested a furnace for melting pure iron. Mr. Carl Hering remarked that there seems to be but little hope to reduce iron by electrolysis from the ores for two reasons; first, on account of the large area of the tanks required for deposition and secondly, on account of the large energy required. He asked why in the Burgess-Hambüchen process wrought iron or steel is used for the anodes. Cast iron would be much cheaper. Messrs. Johnson and Richards explained that the reason was probably that anodes of cast iron disintegrate too rapidly and the amount of anode scrap is then excessive.

THE REDUCTION TEMPERATURE OF ZINC OXIDE.

A paper was then presented by Mr. Woolsey McA. Johnson, of the Lanyon Zinc Company, on thermo-electric determinations of the reduction temperature of zinc oxide. The author described the furnace used for this purpose and pointed out that Acheson graphite can be so easily machined that it can be used for furnaces or apparatus of almost any form. The methods of the determinations were described in detail. Some of the results are given in the following table:

Material to be Reduced.	Reducing Material.	Corrected Mean of Means.
C. P. Zinc Oxide	1100° Charcoal	1022° C.
C. P. Zinc Oxide Calcined at 1300° C.	1100° Charcoal	1025
C. P. Zinc Oxide	Soft Coke	1029
C. P. Zinc Oxide Calcined at 1300° C.	Soft Coke	1061
C. P. Zinc Oxide	Graphite Turning	1084
Roasted Colorado Ore	Soft Coke	1029
Roasted Joplin Ore	Soft Coke	1073
Roasted Joplin Ore	1100° Charcoal	1059

The results bring out quite clearly what has been the somewhat indefinite opinion of zinc smelters from practical observation, namely, that the temperature of roasting effects the ease of reduction and that different reducing materials have different rates of reduction. He also proposed the hypothesis that the reduction of zinc oxide is caused by the very slight vapor pressure of solid carbon and the slight dissociation pressure of zinc oxide tending to break up the zinc oxide into zinc and free oxygen.

Mr. S. S. Sadtler then showed some samples of porous diaphragms which may be ground down to any convenient thickness, so that their resistance is very small. Mr. C. J. Reed read a letter from Prof. Bancroft in which he called the attention of the Society to the "relative decimal card index for electrochemical interests," suggested by Mr. L. Voege in Zürich, Switzerland. The members of the Society were asked for co-operation. A paper by Mr. Voege on this subject had been sent, but was not read at the meeting. It will be published in the *Transactions* of the Society.

The following three papers were not read or discussed at the meeting, but advance sheets were distributed:

DISSOCIATION BY MEANS OF ALTERNATING CURRENT.

A note by Mr. William H. Davis referring to some experiments made for the purpose of perfecting a method of recovery of cyanogen from the double salts of a cyanide solution. The author describes an experiment in which he found that with the use of a porous cup, rendered semi-permeable with copper—ferro-cyanide, "an alternating current would raise the estimated pressure of a solution concentrated so that complete dissociation was not present."

ELECTROLYTIC PREPARATION OF WHITE LEAD.

In a paper by Mr. C. F. Carrier, Jr., some observations are recorded on the preparation of electrolytic white lead. The author investigated whether basic lead carbonate of the desired composition can be produced by some process differing essentially from that of Luckow, and the process of Richards and Roepper was chosen as the subject of the experiments. It consists in electrolyzing a 5 per cent. solution of a mixture of 1 part Na_2SO_3 and 40 parts CH_3COONa with lead anodes, a small quantity of some nitrate being added to aid the solution of the anode. With a current density of 100 to 200 amp. per m^2, the acetic acid anions are supposed to be decomposed at the anode, yielding CO_2 to precipitate the white lead, the necessary admixture of hydroxide being formed by action of the sulphite.

The author found that the use of copper cathodes reduces the voltage between the cell terminals. With a current density of 100 amp. or more per m^2, the anode dissolves irregularly, "pitting" badly. With a solution containing enough hydroxide to precipitate white lead, spongy lead is deposited on the cathode. To prevent a large deposit of lead on the cathode, it would seem necessary to have a permanent store of CO_3 ions in the solution, thus making Na_2CO_3 or other soluble carbonate an essential constituent of the electrolyte. The solution effect of nitrates on lead, when added to the acetate solution, seems to have a higher efficiency than chlorates alone. The tendency of lead to deposit on the cathode is less with the more dilute solution.

FERRO-NICKEL FROM PYRRHOTITE.

A paper by Mr. E. A. Sjöstedt gives an account of electric smelting experiments made at Sault Ste. Marie for the manufacture of ferro-nickel from pyrrhotite. The problem presented for solution consisted in the utilization to the best advantage of the nickeliferous pyrrhotite of the Sudbury district, with special reference to the saving of the sulphur and iron, as well as of nickel and copper contained in the ore. It was decided to hand-sort the ore at the rock house using the grade higher in copper and gangue for the ordinary matte smelting, and the grade low in copper and gangue, but high in sulphur and nickel for the ferro-nickel industry. Since this latter ore with its high sulphur content requires a large excess of basic admixture which, however, results in a slag too refractory to be kept fluid by the blast furnace heat, it was decided to try an electric furnace process.

He describes various preliminary experiments. The final furnace used is shown in Fig. 2, and contains a rectangular water-jacketed

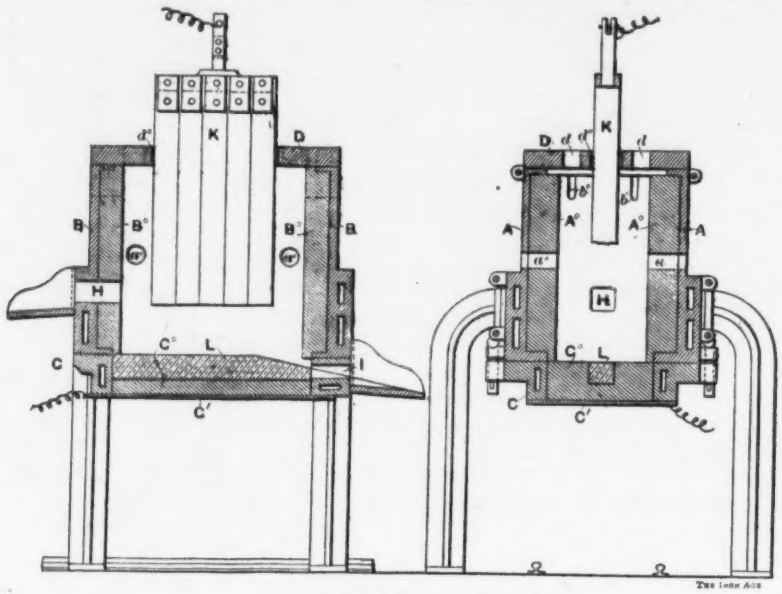


FIG. 2.—SJÖSTEDT FURNACE.

body case, *A B*, with refractory lining, A^0B^0, provided with a slag notch, *H*, vent holes, a^0, and stroke holes, b^0, a water-jacketed bottom frame, *C*, held removably on that body, and provided with a refractory lining on a plate, C^1, screwed to that frame, and having a tapping hole, *I*, provided in one of the ends; a cover of refractory material, *D*, having feed and vent holes, *d* and d^1, and opening for the electrode; an upper electrode, *K*, and a bottom electrode, *L*, embedded in the bottom lining, C^0, and its ends in contact with the metallic frame of the bottom.

In this furnace ferro-nickel was made for several days from poorly-roasted ore (with about 3 per cent. sulphur and about 53 per cent. iron) at the rate of 60 pounds per hour with an electric energy of 108 kw. With a furnace of 300 or 500 hp, which would be more economical, 200 hp would probably suffice for obtaining a gross ton of ferro-nickel per 24 hours. He gives an estimate of the cost from which he concludes that a profit of over $5 per ton metal produced could be obtained. The process has, however, not yet been established on a commercial scale.

Technical Education.

In a very interesting address recently delivered before the Thomas C. Clarkson Memorial School of Technology on Founder's Day, Dr. F. A. C. Perrine took as his subject, "The Success of the Educated Man," which he treated largely with reference to success in science and engineering. Referring to the importance of fundamental knowledge, he said: "The student often chafes at the beginning of engineering and professional training at the apparent remoteness of the technical knowledge itself. He wonders at the very deep foundation being laid before he begins the study of its applications. If he be a true student and is to become a successful man, it is this foundation which in future will remain and form the basis of his power, remaining even after the whole superstructure has been swept away. Conditions change and methods change, and only scientific fundamentals remain. The arts of to-day have been rapidly changing arts, and indeed the knowledge of to-day is often, we may almost say always the ignorance of to-morrow. Power only comes to him who can build continuously while sweeping aside from his foundations the structures so fondly thought stable; and beginning anew, mount each time higher and higher with a more and more stable superstructure."

Magnet Steel.

During the past several years considerable work has been done abroad on the subject of producing a magnetic material for electrical purposes uniting the properties of high permeability and low hysteresis. One of the most promising outcomes is a magnetic material patented several months ago by Robert A. Hadfield, of Sheffield, England. From the patent specifications, the following is abstracted. An important feature of the process is the heat treatment described:

The object of the invention as stated is to produce an improved material having specially high permeability and electrical resistance and low hysteresis qualities. These qualities can be produced by alloying iron with other elements, among which are silicon and aluminum, phosphorus also yielding satisfactory results, as well as combinations of two or three of these elements.

Pure Swedish or other suitable pure iron is melted in a common crucible or electrically along with silicon or aluminum or phosphorus, employing a percentage of these additions varying from one-quarter of one per cent. to 5 per cent. Only one of the three elements mentioned or two of them, or all three may be employed. Instead of the crucible process the decarbonized or desiliconized iron produced by any steel-making process—such as the open-hearth, the pneumatic or the electrical process—may be used, adding to such iron the desired percentage of silicon, aluminum or phosphorus. The molten alloy is then poured into suitable ingots.

As an example of the exact composition of the alloy produced, one actually manufactured contains 2.75 per cent. silicon, .07 per cent. carbon, .08 per cent. manganese, .03 per cent. sulphur, .03 per cent. phosphorus.

The material produced as above described is valuable on account of its high magnetic permeability, its high electrical resistance, and low hysteresis for efficient use in transformers and other electrical apparatus in which these qualities are useful.

The superior qualities of improved alloy can be still further enhanced by a treatment involving alternate heating and cooling and generally carried out as follows: The material is first heated to between about 900° and 1,100° C. and allowed to cool, preferably quickly. Then it is reheated to between about 700° and 850° C.—that is, to a temperature lower than the one attained during the first heating—and then allowed to cool very slowly. In practice the cooling has been often extended to last several days. Either one or both of these treatments may be frequently repeated, or after the first treatment has been carried out the second type of heating may be frequently repeated. A steel alloy of the composition above mentioned may be taken, heated to 1,070° C., cooled quickly to atmospheric temperature, reheated to 750° C., cooled slowly, again reheated to 800° C., and again cooled slowly. When the best results are desired it is of great importance to use the exact temperatures that correspond to these results, and careful pyrometer readings should be taken for this purpose. It is important to keep the percentage of elements, such as carbon and manganese, which are not used for the purpose of the invention, as low as possible—say carbon under about .12 per cent. and manganese under about .12 per cent.

It will be seen that a certain proportion of pure iron is replaced with a body such as silicon, aluminum or phosphorus, which are materials of low magnetic properties or so-called "non-magnetic" materials. This addition has a very remarkable effect on the magnetic permeability, the electrical resistance, and the hysteresis quality of the alloy produced. In fact, the improved alloy has a higher magnetic permeability and a lower hysteretic constant than any magnetic body of which there are data, including the purest iron. This remarkable result may be due to the strong chemical affinities of the aluminum, silicon, on phosphorus for oxygen and the halogens.

Aluminum and phorphorus and their combinations with each other or with silicon are to be considered equivalents of silicon for the purposes of the invention, as well as any other element or combination of elements which will produce the same result—to wit, a greater magnetic permeability, a higher electrical resistance, and a lower hysteresis quality than is exhibited by the purest commercial iron obtainable.

New Telephone Patents.

MESSAGE-COUNTING DEVICES.

The establishment of the message rate system of telephone charges upon so sound a basis that it completely overshadows its predecessor, the flat rate system, brings almost every exchange manager face to face with the knotty problem of recording individual calls. For years the operators have been burdened with the responsibility and labor of writing charge checks, and although the very appreciable drag upon the service rendered necessary the employment of more operators than previously to handle a given amount of business, the extra expense of these was more than compensated by the savings in other directions. With the recent rapid growth in the telephone subscriber list, and the accompanying and necessary tendency toward larger and larger switchboards, the annual charges on switchboard for each extra operator bid fair to counteract the advantages of message charging. In the endeavor to meet the emergency all sorts of message-counting devices have been produced, ranging from a completely automatic and unsuccessful meter at the central office, to slot machines on the subscriber's premises. Many of these devices have the defect that unscrupulous users may "beat" them.

Recently there have appeared patents for three devices designed to avoid this possibility by so arranging the apparatus than conversation with a desired party can only be carried on after a toll has been registered. In all three of these devices the counting mechanism is at the premises of the subscriber and all tolls are registered manually by him.

The first of these systems has been invented by J. H. Meyer, of Magdeburg, Germany. Herein there is located at the subscriber's station in addition to the usual apparatus, a push-actuated counter and an associated instruction target. At the central office the pairs of connecting cords have a switching key and two listening keys. Of these latter one gives connection toward the calling subscriber only, while the other is used in connection with the called subscriber only. The operation of the system may be described in general terms as follows: Upon the central office operator receiving a calling signal and making response with the proper answering cord and associated answering listening key, and the desired number is ascertained, she completes the connection to the called subscriber. For communicating with him the calling listening key must be used. When the operator desires the calling party to converse with the called one, she manipulates her switching key. This latter performs several functions, but most important for our present purposes is that of energizing a relay in the cord circuit, to open one of its lines and thereby separates the calling and called lines, and the sending of a current impulse to the calling station to display the instruction target through the agency of an electromagnet, the target bearing a legend, "Please press the button and then call." When the button is pushed the count is registered, the target obscured and the cord circuit by the release of the cord circuit relay automatically completed, thus permitting through conversation.

A second of these systems is described in a patent granted to F. R. McBerty, of Evanston, Ill., and assigned to the Western Electric Company. In this system the answering response of the operator causes a current to flow through a polarized magnet at the subscriber's station in a manner to release a latch controlled by its armature. This results in a half count upon a register associated with the subscriber's instrument. Upon the response of the called subscriber, the operation of cord circuit relays controlled thereby, reverse the circuits toward the called subscriber and cause through the agency of his polarized relay a short-circuiting of his transmitter. He can, therefore, hear the responding voice of the called party, but cannot converse with him until he has removed the short-circuit about his transmitter by pushing his counter button and charging up a call on his register.

The third system upon these same lines is the combined work of F. R. McBerty and of Charles E. Scribner, of Chicago. The patent for this system is also assigned to the Western Electric Company. In this system a short-circuiting of the transmitter is caused by the first response of the operator, it being necessary for the subscriber to press his counting button upon the request of the operator, before he can give the desired line number to her for connection.

TELEPHONE CABINET.

Under the above title there has been patented by W. B. Atlick, of Lancaster, Pa., a telephone enclosing booth designed to shield the user from extraneous noises. This booth comprises a stationary floor, roof and side pieces, the whole adapted to be closed by a folding curtain which registers at its top and bottom with floor on roof rails. A horizontal cross-section has the shape of the letter D, the rounded portion being the closed curtain. When open the curtain, made of vertical strips hinged together bellows fashion, passes into a small space behind one of the side boards. Glazed lights, in either side board and a roof window admit the necessary light.

IMPROVED POLARIZED RINGER.

Every telephone man is familiar with the polarized bell to the extent of a recognition of the necessity for adjustment of the relative positions of the armature and magnet poles, and everyone who has attempted to regulate this adjustment must have been impressed by the awkwardness of that arrangement most common, namely, that in which a brass yoke carrying the armature trunions, is driven and clamped upon threaded frame posts by means of two nuts. Mr. W. W. Dean, of Chicago, has invented a bell in which other means for accomplishing this adjustment is provided. This is shown in Fig. 1, which is a sectional view of the armature end of the magnets.

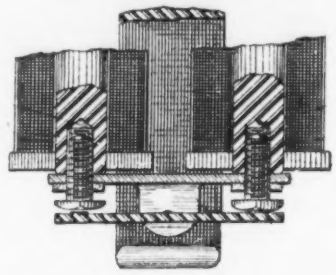


FIG. 1.—DEAN BELL.

As may be seen, extension poles in the shape of bolts with hexagonal heads are threaded into the pole pieces, lock nuts on these serving to securely clamp the brass yoke piece against the core ends. Experience only can prove how much of an improvement this is over the usual adjusting means. The Kellogg Switchboard & Supply Company has obtained the patent for this ringer, by assignment.

SELECTIVE SYSTEM.

Fig. 2 shows a novel sort of selective system, in this case arranged for four stations. Each station is equipped with a special

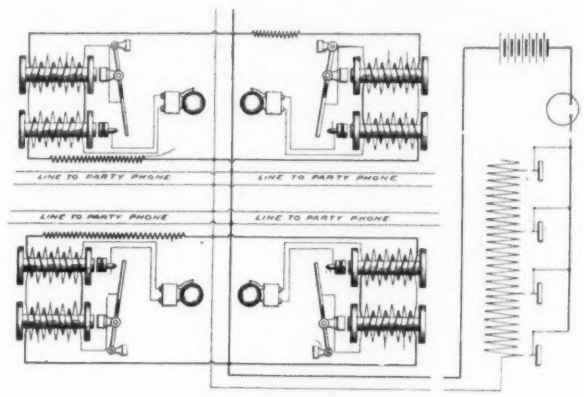


FIG. 2.—GÉHRUNG SELECTIVE SYSTEM.

limit relay, the contact of which controls the local bell circuit. The limit relay is comprised of two electromagnets, each with its own armature. One of these armatures carries the contact anvil, while the other carries the contact. The electromagnets at each station are in series and are bridged on the line through a greater or less resistance. The condition for sounding a signal is that while the contact anvil armature at the desired station is not attracted toward its magnet, the contact armature is attracted toward its magnet. In order to bring this about the magnets are adjusted to begin to respond at definite currents and are so arranged that as the current at which the anvil magnet of one station just fails, the contact magnet of the next succeeding station just operates. For example, when station 1, shown in the lower left-hand corner, is desired, the operating current is put on the line at the central office through a resistance such that while the anvil armature of No. 3 fails to respond to its magnet, the contact armature responds, causing a closure of the bell circuit thereat. At station No. 4 at the right of No. 3 neither

armature responds and thus the bell contact remains open, while at both Nos. 1 and 2 both armatures respond and thus the anvil is kept from contact with the contact point and the bells fail. The patentee of this system is J. A. Gehrung, of St. Louis.

St. Louis Street Railway Convention.

A decision to hold the 1904 convention of the American Street Railway Association at St. Louis was reached at the meeting of the executive committee of the association held at that city recently, as already noted. It was found that the World's Fair management would designate October 12 as "American Street Railway Association Day," thus making it one of the formal days of the Exposition. They also promised the association their cordial co-operation in making the meeting a success in every respect, and also placed at the disposal of the association for its meetings "Recreation Hall," which is in the great building known as "Festival Hall," and is located in the central part of the grounds. For the meetings of the subsidiary associations they offered smaller halls in the same building. As October is a very attractive month in St. Louis, it was decided to accept these offers and designate October 12 and 13 as the days of the convention. It was also proposed to make the entire week commencing with Monday, October 10, one which would offer special attractions to street railway men, and to this end it has been suggested that the American Railway, Mechanical and Electrical Association should hold its convention on Monday and Tuesday, October 10 and 11, and that the Street Railway Accountants' Association should hold its meetings on Friday and Saturday, October 14 and 15. The annual banquet will be held on Thursday evening, October 13.

The Southern Hotel has been designated as the headquarters of the association. There are a large number of other hotels, however, among them "The Inside Inn," which is the large building erected within the Exposition Grounds for the accommodation of visitors, and which will undoubtedly be patronized by a great many people. The secretary of the association is now preparing a circular which will give such information as will enable any person by the exercise of a little care to be well located during "Convention Week" at the Fair. The association will also send to all members before the meeting, a book giving the names of every hotel and lodging house in St. Louis, their location and the rates per day and week, and will exercise every endeavor to have all attendants at the convention well cared for. Assurances were also secured from leading hotels in regard to rates, and were regarded as very satisfactory.

The Metric System.

We have received from Mr. George W. Colles a lengthy communication on the metric system, in which it takes issuance with some statements in favor of the system which have appeared in these columns. The arguments may be condensed as follows:

The favor shown by the British Colonies for the metric system is of no moment, for, as far as that system is concerned, there is no more connection between Great Britain and Canada, or Australia, than between Great Britain and the United States. He states that the action by the Colonies has been in a series of petitions and resolutions, legislative or otherwise, and the Colonies that have acted are confined to the Transvaal, Australia, Cape Colony and New Zealand, in which "raw ochlocracies about any kind of law or propaganda may be expected to take root." The adoption by Great Britain of the metric system has, he asserts, been vigorously urged for more than fifty years, but without effect; on the other hand, the Imperial system of weights and measures, first established in 1824, has been steadily improved and consolidated by successive further acts of Parliament, "which leave no doubt as to the sort of progress that Great Britain is really making." It is stated that the comparison of the metric system to a labor-saving machine is an old stock in trade, and has been knocked in the head so many times that it "ought to be dead, even if it isn't." Prof. Charles Davies, who is pronounced one of the most eminent specialists of education that this country has produced, opposed the labor-saving view, and it is stated that the University Convocation of the State of New York, which is pronounced an eminently competent body in education, reported its emphatic opposition to the system on this particular ground.

CURRENT NEWS AND NOTES.

DISCUSSION OF INSTITUTE PAPERS.—In the report in our issue of April 2 of the discussion of the Institute papers read at the March meeting, the several references to remarks stated to have been made by Prof. D. C. Jackson should have credited the authorship to Mr. William B. Jackson instead.

THE TROLLEY AND THE FARM.—According to State Statistician Johnson, of Indiana, the dearth of farm hands in that State is due to the rapid development of the interurban electric railway. The uncertain hours of farm work, it seems, cause men holding steady jobs to give them up in order to assist in building an electric railway, and then permanently to abandon their former line of work if a position as motorman or conductor is available, or they can secure any other berth on the road.

MOVING A MEXICAN TOWN.—Advices from Mexico say: "The Mexican Light & Power Company, which is installing the great water power and electric transmission plant in the State of Puebla, ninety miles from the City of Mexico, has just completed moving a town of 1,000 population. The engineers found that the town of Necaxa occupied a site particularly suitable for the necessary reservoir, and the company forthwith purchased the entire town and moved it to a new location. All the buildings, including the Catholic Cathedral, were razed and reconstructed on the new site. The new town bears the name Canadita. The initial capacity of the plant will be 45,000 hp. F. S. Pearson, of New York, is the engineer."

CHICAGO MUNICIPAL OWNERSHIP.—The chief interest in the recent city election in Chicago centered in the vote on the proposed municipal ownership of the street railways. In this connection what is known as the "Mueller law," passed by the last Legislature, was submitted to the people. The law authorizes cities in Illinois to construct, own, operate and lease street railways, and to provide the means therefor. The vote stood 152,433 for and 30,104 against the proposition. On the proposition that the city should at once take over the street railways into its control the vote stood 120,744 for and 50,893 against. For the temporary licensing of street railways until such time as the city is prepared to take them over, the vote was 120,181 for and 48,056 against.

SCENIC TUNNEL AT NIAGARA.—The new scenic tunnel, run under the Horseshoe Falls of the Niagara, was recently opened for inspection of the engineers and park authorities by the Ontario Power Company. This tunnel cost the power company over $25,000, and is designed to present the grand scenic beauties of the cataract as never before seen. A shaft was sunk 127 ft. from the interior of the Table Rock House, and from the bottom the tunnel runs a distance of over 800 ft., following the contour of the Horseshoe, and coming out under the first heavy fall of water over the brink. Small lateral tunnels run from the main one into the gorge. The shaft has been walled up and an electric elevator installed, from the foot of which to the mouth of the main tunnel is a broad plank walk. Immense glass observation rooms will be constructed at the mouth of the lateral tunnels, where the visitor, reclining in an easy chair, can view the fierce onrush of the great torrent.

ANGLO-FRENCH TELEPHONY.—The telephone service between London and Paris was extended on April 11 to the provincial towns in England and France, between which communication is at present practicable. The charge will be $1.92 for a conversation of three minutes, except in the cases of Bordeaux, Lyons, Marseilles and St. Etienne, when $2.40 will be charged. Subscribers in London will be able to communicate with the following towns: Amiens, Armentières, Bethune, Bordeaux, Boulogne, Caen, Calais, Cambrai, Chartres, Denain, Dieppe, Dijon, Douay, Dunkirk, Elbeuf, Havre, Lens, Lille, Lyons, Marseilles, Nancy, Orleans, Paris and suburbs, Roubaix, Rouen, St. Etienne, St. Quentin, Tourcoing, Tours and Valenciennes. Communication will at the same time be available between the post offices at Birmingham, Bradford, Brighton, Bristol, Cambridge, Cardiff, Derby, Hull, Ipswich, Leeds, Leicester, Liverpool, Lowestoft, Manchester, Newport (Mon.), Norwich, Nottingham, Sheffield, Southampton and Yarmouth, and renters of wires into those offices on the one hand and Paris and certain of the abovenamed French towns on the other.

TRANSMISSION LINE MEETING IN CHICAGO.—The Chicago branch of the A. I. E. E. will hold a meeting the evening of April 26 to discuss "High-Tension Lines."

STREET RAILWAY CONVENTION.—The annual convention of the American Street Railway Association is to be held at St. Louis, Mo., on October 12 and 13, with headquarters at the Southern Hotel. Secretary T. C. Penington announces that a circular on the subject will be issued in a few days.

HIT BY A SHOE.—Brides and bridegrooms have been known to be seriously injured by the blow received from old shoes thrown after them for luck, or to express the jealous disappointment of the thrower. But for dangerous missiles, of this kind, the palm should be awarded apparently to those used on the Brooklyn elevated system. One of these shoes, accidentally detached from the car, fell on a mounted policeman, smashed his hat, cracked his skull, and sent him into hospital badly wounded.

N. E. L. A. QUESTION BOX.—The interest in the "Question Box" of the National Electric Light Association is indicated by the fact that the preliminary list of questions for consideration at the coming Boston meeting numbers almost 450, the greater part referring to station operation. We understand that a large proportion of the questions have already received answer in communications, thus showing that the interest is not only on the part of those who "want to know." The section of the transactions comprising this feature should be of unique value to members of the association, and in itself tends to largely increase the membership.

EQUIPPING ILLINOIS CENTRAL.—It is reported from Chicago that the Illinois Central is negotiating for twenty motor cars for use in the suburban service of the company. It is said that the order for the motor cars has been given to the General Electric and that the order will be increased to forty motors within a year. It is well known that the Illinois Central has had a standing offer to adopt for the suburban traffic any electric system which could be demonstrated to be equal to the work. If electricity is adopted as a motive power it is expected that the suburban trains eventually will consist of electric motors drawing steel side door cars, the latter being practically indestructible. The conditions of traffic in and around Chicago are regarded as very favorable for electric traction.

MENELIK'S TELEPHONE.—An interesting report has been received by the Navy Department from Lieut. Hussey in command of the escort for United States Consul R. P. Skinner, who recently visited Emperor Menelik, of Abyssinia for the purpose of negotiating a treaty. One of the most surprising things in connection with the expedition was the fact that the Emperor was kept informed by telephone of the progress of the American party. Three days were spent at Harar, where the Emperor's nephew called up his uncle by long-distance telephone to tell him that the Americans were coming. The Americans were met in state outside of the royal settlement and escorted to the Emperor, the time arrangement of the programme being made possible by the use of that great civilizing agent—the telephone.

WIRELESS TELEGRAPHY IN THE WAR.—According to the London *Electrician* of March 25, "The longest press message yet transmitted by wireless telegraphy appeared in last Monday's *Times*. It was about 1,400 words in length and had been transmitted by wireless telegraphy from the *Times* dispatch boat with the Japanese fleet to Wei-Hai-Wei, and thence by ordinary cable. The *Times* not only commissioned a dispatch boat so as to secure early news from the seat of the war, but also enterprisingly wired to the De Forest Wireless Telegraph Company in America to fit up an installation upon it, and a corresponding station on the mainland at Wei-Hai-Wei. The De Forest Company claims for this apparatus a speed of from 20 to 30 words per minute, and probably the range of a ship's installation would be at least 100 miles—possibly greater if local circumstances are propitious. The stations are attended to by members of the De Forest Company's staff, and although not completed quite so quickly as was anticipated at the *Times* in London, to judge by the result in Monday's paper it should now be working most satisfactorily."

LETTERS TO THE EDITORS.

Individual Motor Drive.

To the Editors of the Electrical World and Engineer:

SIRS:—Referring to my letter published in your issue of March 12 and Mr. Cooper's criticism of the same in your issue of March 26, I would like to state that whether or not motors can be obtained that will operate over a wide range of speed without sparking under weakened field, is not a question of theory but one of fact. I can testify to having seen and tested such motors in practical operation, as well as under a controllable generator load.

In one of these tests a motor frame rated as 10 hp at 825 r.p.m., with full field strength delivered 3 hp at speeds varying from 250 to 1,100 r.p.m. This motor was belted to a generator whose load was varied so as to keep approximately 12 amp. at 220 volts flowing through the motor armature. The field current was varied by the rheostat from 1.05 to .3 amp., resulting in the speed variation above mentioned. The load was then increased to 18 amp. in the motor armature, with the field current remaining at .3 amp., resulting in a slight falling off in speed, and so little of sparking at the tip of the brushes that it would not be noticeable except by very close scrutiny. This motor weighed approximately 1,050 pounds, and can be purchased for a trifle over $200, and is a perfectly practical and commercial device. I have also seen in practical operation many other motors whose speed was regulated over a wide range by altering the shunt field strength.

The 5-hp motor to which I referred in your issue of March 12 was tested by both the superintendent and first assistant engineer of the Cutler-Hammer Manufacturing Company before I wrote you about it. This company is at least alive to the fact that the variable-speed, constant-voltage motor has reached a practical, commercial stage, and it has developed a special drum controller for use in connection with these motors for driving various machine tools, etc., which has already entered largely into use; 14 will be in operation at the St. Louis Exposition shortly after May 1, where they may be seen. The horse-power capacity of the motors to be used with these controllers varies from 1 to 10, and the speed variation from 2 to 1 to 4 to 1. Motors can be obtained of at least one manufacturer that will commutate well over a speed variation as high as 6 to 1. So much for facts.

Now for Mr. Cooper's criticism of my rules for determining the size of suitable motors. Reference to these rules as printed in your issue of March 12 will show that I specifically limited them to motors designed to operate at variable speed under variable field strength, within, of course, the limitations of speed for which the motors were designed. The rules which I drew up were intended to be up to date, and are not applicable to motors designed in the nineteenth century.

It is true that I did not state how to design a satisfactory variable-speed motor, for, to be candid, I do not know how, and would not tell if I did. I do know, however, and stated plainly, that there are a great many elements of design which affect the degree of sparking. I know, further, that there has been no radically new discovery made which enables expert designers to produce motors that commutate well under wide variations of field strength. This result has been attained by considering each and every factor of design that tends to reduce sparking with the utmost care, and applying expert skill of the highest order to produce a harmonious blending of all these various factors. It is enough to proclaim that certain expert designers have succeeded, and that the great boom in the individual application of motors, which Mr. Cooper states would result, is now due.

MILWAUKEE, WIS. H. H. CUTLER.

Oerlikon Vertical Motor-Generators.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of March 26 you are so kind as to publish an article descriptive of the vertical motor-generator sets as installed by our firm at Lend-Gastein. Unfortunately, an erroneous statement was made in the article on page 609 where you say: "The motors are of the synchronous type." As a matter of fact, they are non-synchronous. Will you kindly correct this in one of your next numbers. The motors have their rotor windings short-circuited upon

themselves. The starting of the motor is performed by starting the generators, which are, of course, separately excited.

OERLIKON, SWITZERLAND. E. HUBER.

The Telephone Receiver in Electrical Measurement.

To the Editors of Electrical World and Engineer:

SIRS:—Having once investigated the use of telephone receiver for the measurement of capacity, inductance and resistance, I was much interested by Mr. J. A. Campbell's article on the "Shielded Balance" in your issue of April 2. I will not criticise the principle of the shielded resistance, but can say at once that such a device will be of little service in improving the utility of the telephone receiver in connection with the Wheatstone bridge. The trouble is mainly in the electromagnetic induction between various parts of the bridge, and the capacity effect is comparatively small in ordinary cases, except when using extremely high e.m.f. To avoid the electromagnetic induction in such case by means of magnetic shields of iron is, of course, physically impossible.

In short, it is a mistake to cling to the Wheatstone bridge when we have to do with alternating current, and the right solution is to be found in the use of differentially-wound telephone receivers on which I contributed an article to your issue of May 23, 1903. On further investigations, my methods proved wonderfully accurate for measuring capacity, inductance as well as resistance, and I could even measure with accuracy the capacity of a spherical conductor only 3 inches in diameter isolated in space in a laboratory of Tokio Imperial University. I sincerely wish that Mr. Campbell would try a differential receiver, in which, I am sure, he will find a very practical thing.

I take advantage of this occasion to correct an error. In my former paper I stated that a certain relation between capacities and resistances was required for the measurement of capacity, but I found afterward that such was not at all necessary, as may be easily proved.

SCHENECTADY, N. Y. H. HO.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Output and Design Coefficient.—PRESS.—A communication in which the author proposes the following output equation: Output in watts equals the "design coefficient," multiplied by revolutions, multiplied by the square of the diameter of the armature, multiplied by the sum of the core length and the length of the end connections. The design coefficient equals the final temperature rise multiplied by the radiation capacity of unit surface at unit peripheral speed, divided by the product of the armature loss factor and the total loss of efficiency factor.—Lond. *Elec.,* March 25.

Variable-Speed Motors.—BURLEIGH.—An illustrated article on speed variation of speed current motors. To obtain the best results, the reactance volts at maximum speed should not exceed 2.5 and the ampere-turns per pole should never be less than the ampere-turns required for the gap. For motors up to about 20 hp a four-pole machine with series-wound armature and four sets of brushes seems to be the best. At a voltage of 220 a very good motor can be fairly economically produced with a speed ratio of three to one or even four to one, while a speed ratio of two to one is quite high enough for a 500-volt motor. The author gives the complete data of the design of a 4-hp motor for 400 to 1,200 revolutions at 110 volts and for a 6-hp motor for 300 to 900 revolutions at 220 volts (making use still of the old Kapp lines).—Lond. *Elec. Rev.,* March 25.

REFERENCE.

Tandem Connection of Induction Motors.—MÜLLER.—A mathematical article in which the author refers to the fact that the well-known Heyland-Behrend circular diagram of the induction motor in its original form does not apply to speeds above synchronism. He now shows that for the tandem connection the diagram for speeds above synchronism also differs from the ordinary diagram.—*Elek. Zeit.,* March 24.

LIGHTS AND LIGHTING.

Mercury Vapor Lamp.—An illustrated description of a new type of mercury vapor lamp designed by Bastian and Salisbury (its efficiency being lower than that of the Cooper Hewitt type and its chief commercial advantage being apparently the convenient shape of the lamp). Fig. 1 shows the lamp in its normal position. *E* is a spun copper bell-shaped cover which protects the internal mechanism from wet and provides a means for suspending the lamp and fixing the tubes and other devices. *G* is an ordinary glass globe. As shown in the illustration, the lamp is not at work, and the mercury in the tube, *T,* connects the two wires sealed into the glass. Fixed to one end of the glass tube is an iron plunger, *C,* which acts as a core to the electromagnet, *M.* The resistance, *R,* the electromagnet, *M,* the carbon filament lamp, *L,* and the mercury in the tube, *T,* are all connected in series. On closing the switch the core, *C,* is drawn up by the electromagnet; *T* being pivoted at *P* and the continuity of the mercury being broken, an arc is formed. The tilting of the tube is thus effected automatically. The pressure of the mercury vapor set up by the arc then forces the mercury up into the left-hand bulb and thus cuts out the auxiliary resistance, *R.* All these operations occupy but the fraction of a second. The carbon filament lamp, *L,* just above the mercury tube, is added for the purpose of overcoming the absence of red rays and this lamp is, therefore, under-run so as to make its radiation rich in the required red rays. An efficiency of 2½ cp per watt is claimed when the carbon auxiliary is not used

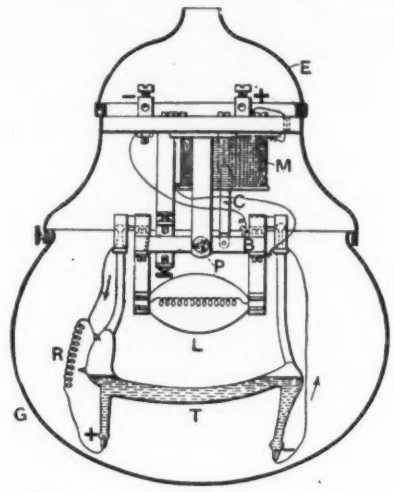


FIG. 1.—MERCURY VAPOR LAMP.

and of 1 to 1.5 cp per watt when the latter is used. Each lamp requires from 40 to 60 volts and 0.65 amp., the candle-power being 80. Lamps have been run both continuously and intermittently for over 1,500 hours and the inventors believe that the average life will be about 3,000 hours. The lamp is intended especially for side street lighting to compete with incandescent gas light. Editorially, it is stated that apparently the color defect has not been entirely overcome; "although the condition of the over-run carbon lamp does constitute a distinct improvement, yet the rays do not mix as well as might be expected and the resulting illumination is still of the nature of moonlight." The resistance of the carbon filament in series decreases the voltage across the terminals of the mercury tube and consequently the length of this tube.—Lond. *Elec.,* March 25.

REFERENCE.

Train Lighting.—ALIAMET.—An illustrated article on the system of train lighting used by the Northern Railroad Company in France. The incandescent lamps are supplied with current from storage batteries placed in each car, so that the different cars are independent from each other. The storage batteries are charged in the stations

and are connected in series for this purpose. Since the number of cars in a train changes from train to train and from day to day, and since on the stations either 115-volt direct-current or 85-volt two-phase current are available, it was necessary to transform the voltage so that it fits the number of storage batteries to be charged in each case. This is done by means of the Lanhoffer voltage transformer, the principle of which was described in the Digest last week. Drawings are given of this machine and of the connections used for charging.—*La Revue Elec.*, February 15.

Power.

Electric Winding Machines.—Georgi.—An illustrated paper read before the Glasgow Section of the (Brit.) Inst. of Electrical Engineers. Electric winding machines have made rapid headway during the last few years in Continental Europe, especially in the mines of Silesia and Westphalia. One great advantage of electric winding is to diminish very considerably the coal consumption, which can be brought down to about ⅓ of its original value if a modern generating plant is adopted. The author points out that the utmost security of working is required since the winding engines are not only used for the extraction of minerals, but also for transporting men. The speed of the machine will have to be regulated independently of the load; that is, independently of the current in the armature and with the utmost possible economy. These conditions are stated to be fulfilled in the system of Ilgner, with which it is possible to connect any number of winding engines to any kind of electrical distribution system, without diminishing the favorable steam consumption. The arrangement is based on the fact that a direct-current shunt-wound motor with a field of constant intensity and fed by an independent source runs with a speed directly proportional to the applied voltage and to the number of turns on the armature. The torque is, of course, a function of the current in the armature. If, therefore, a direct-current dynamo is arranged with independent excitation whose voltage can be regulated from zero to a positive or negative maximum by means of a field resistance, then a motor coupled on the same circuit and having a constant field, will run at a speed varying between zero and the positive and negative maximum. The starting of a machine is thus most economical and at any time the energy consumed is only equal to the product of the voltage by the current. In the Ilgner system the current taken from the supply drives a converter, composed of a motor, direct-current dynamo and a heavy fly-wheel. An automatic slipping device is fixed to the motor by means of which, should a dynamo call for energy, and, therefore, the current in the motor have a tendency to augment, the automatic friction clutch is released, the fly-wheel giving up kinetic energy. The weight and speed of the fly-wheel are calculated so that for a given slip the output of the motor remains the same. Thus the winding engine, as far as the supply station is concerned, may be considered as an ordinary motor of constant output. Owing to the motor being shunt wound, the speed is practically independent of the load. Illustrations are given showing the general arrangements of the governing and safety apparatus and also of the motor-driven winding apparatus.—Lond. *Elec.*, March 18.

Steam Turbines.—An illustrated description of the Riedler-Stumpf steam turbine, which occupies an intermediate position between the De Laval and Parsons types. In order to reduce the speed of the shaft, wheels of large diameter are employed, made of 10 per cent. nickel steel with the buckets cut into the periphery. Contrary to the De Laval construction, a rigid shaft is employed, which is supported by either one or two bearings. This is made possible by very accurate balancing. The center of gravity in a 2,000-hp turbine installed in the Berlin electric plant was specified to be within 0.004 in. of the geometrical center. This condition was very well fulfilled and the center of gravity could afterwards be made correct within 0.004 in. The nozzles are square in cross-section. The complete nozzle ring furnishes a full steam-jet ring. If partial admission is intended, the nozzles are united to an arc and the rotor buckets not played upon by the steam are covered, to decrease the ventilating resistance. Between the rotor and the nozzle the clearance is in the 2,000-hp turbine 0.12 in. measured radially and 0.4 in. when measured in the axis of the nozzle. The radial clearance has, it is said, been increased to 0.2 in. without affecting the efficiency. At brake tests of the 2,000-hp set, when the output was 1,917 hp a consumption of 17.6 pounds of steam per kw-hour was observed, the speed being 3,800 r.p.m.—Lond. *Elec.*, March 25.

Italian Hydroelectric Stations.—Bignami.—A fully-illustrated description of the various hydroelectric stations of the Alta-Italia Company, which supplies current for lighting, traction and general power purposes to Turin and a great many towns in the neighborhood. Three-phase currents are generated at 450 volts and the voltage is then raised by transformers to 12,000. This was the voltage originally intended for transmission, but it was later decided to double the transmission voltage and therefore special transformers were interposed which raised the voltage from 12,000 to 24,000. The arrangement is shown in Fig. 2. The special transformers are

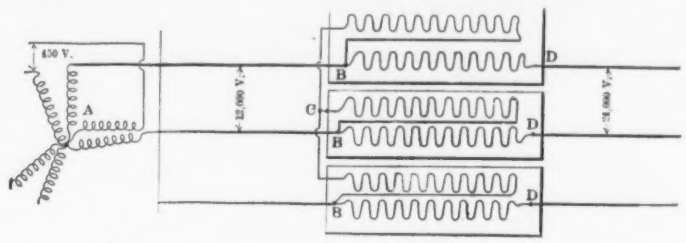


FIG. 2.—DIAGRAM OF TRANSFORMER CONNECTIONS.

single-phase with a transformation ratio of one to one. One of the windings is put in series with the line; the other winding is star-connected at one end to the corresponding circuit of the other transformers, and at the other end is connected with the 12,000-volt line. The arrangement is clearly shown in the diagram.—*Eng'ing Mag.*, April.

References.

Gas Engine.—An illustrated description of the construction of the Nürnberg gas engine. It is stated that the makers guarantee a consumption of this engine of 2,100 calories (8,334 B.T.U.) per effective hp-hour running on blast-furnace gas. This corresponds to a thermal efficiency of 30 per cent. At ¾ load the gas consumption is increased about 10 per cent.—*Power*, April.

Producer Gas and Water Power.—Nagel.—A note in which the author points out that near coal mines producer gas power can be produced at about the price of power at Niagara Falls, and that the blast furnace will be of the same importance as a gas producer, as it is at present as iron producer. A 1,000-hp producer gas plant completely erected and including engine costs about $66,000; figuring depreciation, interest and working expenses with a coal price of $1 per ton, 1 hp for 24 hours will cost 5.55 cents.—*Electrochem. Ind.*, April.

Lubricants.—An article by Doane on the selection and testing of lubricants and another article by Davis on lubricating oils and their properties; how to test them and detect adulterations.—*Power*, April.

Traction.

Accident on Paris Underground Railway.—A long editorial, summarizing and criticizing a report of the technical committee which had investigated the disaster on the Paris Metropolitan Railway in August last. A summary is first given of the causes of the accident, and the lessons from the disaster are summarized for the prevention of similar accidents. The investigating technical committee lays the greatest stress on the requirement that it should be possible for the train staff to cut the current off the conductor rail at any point. For this purpose, it is suggested that the rail should be cut up into a number of separately fed sections, such that not more than five or six trains can be on any one section, and that every train shall carry a "short-circuit bar," which can be dropped across the conductor and running rail in case of need and so actuate the circuit-breakers controlling the section. The committee also urges that the lighting of the stations and tunnels should be provided from a number of sources, some of them entirely independent, not only of the traction supply, but even of the company's generating and sub-stations. It appears that the committee considers that the non-inflammable car is at present hardly attainable, so that short-circuits must be expected, and when they do occur some risk of fire is unavoidable. The writer of the editorial thinks that the committee has inverted the proper order of the measures required and that the essential condition of safety would be to design and equip the motor cars in such a way that ignition of combustible material is hardly possible. "With rubber-covered cables boxed in with wood a shoe that cannot be readily lifted from the rail, and circuit-breakers or fuses set for too heavy a

current, it is conceivable that a short-circuit may put a car into a blaze in a few seconds and constructions carrying such risks must be avoided." It is also pointed out that from what happened it appears that neither train men nor the station staff had been instructed how to deal with an electric fire.—Lond. *Elec.*, March 25.

Rail Bonds.—HARRINGTON.—The conclusion of his Franklin Institute paper giving a summary of commercial rail bonds. Illustrations are given of special rail bonding tools and the ajax bond and the Camden & Suburban Railway bond are described. No. 1 of the latter consists of a square copper casting with two grooves from 4/0 B. & S. gauge copper wire; the casting has a 1 1/16-in. hole in the center. A cast-iron casting with corresponding grooves and hole is provided. The bond is applied by grinding off the web of the rail with an emery grinder and treated with Edison-Brown alloys, serving to amalgamate the surface of the rail and fill valleys and depressions and irregularities of the surface. The 4/0 wires and the copper casting grooves are also treated, the whole is then bolted to the web of the rail with a one-inch bolt, using a lock washer. The bond plates are located each side of the fish or joint plate and are connected by two 4/0 wires. Results of tests are given and Conant's method of bond testing is described as well as the method used by the Camden & Suburban Railway. The latter simply uses a car having mounted therein a barrel of water, rheostat included in circuit, a Weston ammeter, also a Weston voltmeter to obtain line voltage. A small truck with wood framing having two axles and 33-in. wheels on 3-ft. centers, with a Weston millivoltmeter located in the car and having its terminals connected to the axles of the small truck, the car is run so that the small truck will trail between car and power station. As all readings are taken relatively, that is, comparing readings of equivalent joint lengths and solid rail lengths, nothing need be done except to run and make notes.—*Jour. Franklin Inst.*, April.

REFERENCES.

Italian Electric Railways.—A note stating that a new electric railway will be installed from Rome to Naples. Energy will be derived entirely from water power. Another Italian electric railway has been opened from Naples to the base of the old funicular railway. The first and the last section of this line are adhesion roads, while the middle part is a cog wheel line. Gas power is used and for the production of the gas, two Dawson gas generators of 200 hp are employed. They supply gas to two engines coupled to two direct-current dynamos, which are operated in parallel with a storage battery.—Lond. *Elec.*, March 25.

Large Tramcar.—An illustrated description of a tramcar constructed by the Hartlepool Electric Tramways Company, and having a seating capacity of 84 passengers, 42 inside and 42 outside. The total cost, exclusive of trucks, was $700.—Lond. *Elec.*, March 25.

Train Lighting.—See the abstract under "Lights and Lighting."

INSTALLATIONS, SYSTEMS AND APPLIANCES.

British Central Station.—An illustrated description of the municipal electric station of Sunderland. The old plant contains 11 steam-driven generators aggregating 2,165 kw, while the new and principal station is equipped with five direct-current dynamos aggregating 1,280 kw, and three 5,500-volt, three-phase alternators with an output of 2,250 kw. The total capacity of the two stations is, therefore, 5,695 kw. The system has been, until recently, partly the original three-wire, 110-volt system, and partly a two-wire, 220-volt system. The original three-wire system has now been done away with, however, and a uniform system of distribution is obtained from two wires at 220 volts. This system has been adopted partly on account of the large demands which may be expected from the 21 shipbuilding and engine works in the borough, a large number of which were already electrically equipped with 220-volt motors driven from the works' own generating plant; and partly because of the steady development towards sub-station distribution in Sunderland. The principle is to generate three-phase currents at one station at 5,000 to 5,500 volts and transmit to sub-stations, where the current will be transformed by motor-generators and distributed to areas, the radius of the largest area not exceeding ⅝ of a mile. In each of these sub-stations will be a large storage battery. Two of the largest shipbuilding works are already connected to the station, one containing 22 motors with an aggregate capacity of 520 hp, the other 23 motors of 445 hp. Two large sub-stations have already been erected capable of accommodating plants to the extent of 2,500 kw.—Lond. *Elec.*, March 25.

ELECTRO-PHYSICS AND MAGNETISM.

Thermoelectric Forces in a Heated Wire.—SCHNEIDER.—Some remarks referring to a former article of Egg-Sieberg, who described a number of experiments in which a uniform metallic wire was connected to a galvanometer and by heating the wire under certain conditions thermoelectric forces were observed. Egg-Sieberg believed that the source of the current was in the unsymmetrical drop of temperature on both sides of the heating point. The author shows that this is not correct, and that also in this case there exists a contact of two mechanically and chemically different bodies, since when an iron wire is heated the iron is partly charged into oxide. From this point of view all the phenomena may be explained.—*Elek. Zeit.*, March 24.

REFERENCE.

N-Rays.—Lummer points out a source of error in the observation of N-ray effects which may easily mislead the observer. It is the conflict between the rods and cones of the retina in viewing a faintly luminous object.—*Phys. Zeit.*, March 1. Bichat has examined a number of metals for their transparency to N-rays, and has found that they show a well marked selective absorption. This offers a ready means of isolating definite homogeneous beams.—*Comptes Rendus*, February 29; abstracted in Lond. *Elec.*, March 25.

ELECTRO-CHEMISTRY AND BATTERIES.

Aluminum.—BENNIE.—A description of a new process for the production of aluminum proposed by Gin. The metallic aluminum is obtained by means of reducing aluminum by a zinc-sodium alloy. The aluminum chloride is prepared from beauxite by means of chlorine by the same electrolytic operation which furnishes the zinc-sodium alloy. The chlorine and zinc-sodium alloy are prepared by electrolysis on one hand of the double chloride of zinc and sodium and on the other of the double chloride of sodium and potassium. These two operations disengage chlorine, the first supplying the zinc destined for the cathodic bath of the second, in which the zinc-sodium alloy is prepared. The reduction which finally yields the metallic aluminum also reconstitutes the double zinc-sodium chloride in such fashion that the various operations form a closed cycle with regeneration of the intermediate compounds.—*Electrochem. Ind.*, April.

Benzine Fires.—JUST.—In chemical cleaning works sudden fires sometimes start when the cleaned woolen materials are taken out of the bath. During the motion of the materials in the benzine, electrostatic charges are produced due to the friction, the benzine becoming negatively and the material positively charged. When the material is taken out, a spark occurs and ignites the explosive mixture of benzine vapor and air. Richter has found that such fires are prevented if 1/20th to 1/50th per cent. of oleate of magnesia is added to the benzine. The present author shows that this is due to the considerable increase of conductivity of the solution. He describes an experiment which shows that electrostatic charges which are being developed are quickly carried off to earth on account of the increased conductivity of the solution.—*Zeit. f. Elektrochemie*, March 25.

REFERENCE.

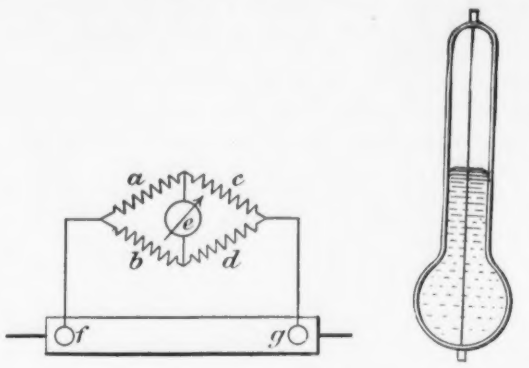
Preparation and Compression of Pure Gases.—HUTTON AND PETEVAL.—An illustrated paper on the preparation and compression of pure gases for experimental work. The authors deal especially with hydrogen, nitrogen, carbon monoxide and ethylene and describe the electrolytic production of hydrogen.—*Electrochem. Ind.*, April.

UNITS, MEASUREMENTS AND INSTRUMENTS.

British National Physical Laboratory.—A long extract of the annual report of this laboratory. While the work has prospered, the financial position gives rise to anxiety. In the electrical department, the experiments made on standard cells seem to show that differences remaining in the mercurous sulphate obtained from different makers, even when repurified in the standard manner in the laboratory, are the main cause in the differences observed between different standard cells. It is hoped that it may be possible to prescribe a standard method of preparing the sulphate, which will eliminate these differences. At present the electrical test of purity is more sensitive than the chemical. The construction of a standard ampere balance has been undertaken according to the designs of Jones and Ayrton. The coils of the balance consist of helices of bare copper wire wound on

marble cylinders and its working depends very greatly on the accuracy with which these coils are wound and measured. The tests on insulating materials will be continued; the investigations now in progress relate to the distribution of temperature within the layers of the field coil of a dynamo or motor. Tests, as ordinarily made, give the mean temperature of the coils and it is desired to know by how much the maximum temperature differs in practice from the mean. Specimens of nickel-steel will be subjected to tests of electric conductivity, permeability, etc. In the optical division the first piece of research is the investigation into the conditions under which the pentane lamp may be considered as standard. Its intensity varies greatly with the quantity of aqueous vapor present and also with the barometric pressure and with the carbonic acid. The pentane lamp can only be treated as a secondary standard, and the next series of experiments will relate to the establishment of some primary standard, e. g., the radiation from a square centimeter of incandescent platinum at a definite temperature, or that from a "perfectly black body" at a definite temperature. In the electrical division of the physics department, the standard British Association air condensers were measured from time to time, their constancy being satisfactory within the limits of accuracy attained. The work in connection with the mercury standards of resistance was carried to a successful conclusion. Of these 8 are of Jena glass and three of verrefdur, the length varying from 60 to 120 cm. Fittings for each tube have been constructed enabling the measured resistance to either include or omit the "end correction," the value of the latter having been determined for the special kind of connecting cups used. The result of the observations on the whole 11 tubes shows that the difference between the international ohm, as defined by a uniform column of mercury 106.300 cm. long and 14.4521 grams mass at 0° C. is known to about 0.001 per cent. The platinum-silver and manganin standards of the British Association were also tested and marked changes were noted in certain coils. In the thermometrical department the research work consisted mainly of a continuation of the investigation on the various high-temperature standards. In addition to the comparisons of gas and platinum thermometers investigations were made on the behavior of thermo-junctions for high temperature measurements, and in particular the junctions of platinum and platinum-rhodium obtained from the Reichsanstalt, where they had been standardized at a number of fixed points. The discrepancies between the instruments were found to be very small. Between the two types of instruments, least affected by temperature lag—namely, the platinum thermometers and junctions—the difference in one set of experiments, extending from 500 to 1,000° C., never attains 1° C. and the several series of independent measurements with different fillings of the gas thermometer concord as closely as could be expected.—Lond. *Elec.*, March 18, 25.

Direct-Reading Switchboard Instruments.—Edgecumbe and Punga.—The first part of a paper read before the (Brit.) Inst. of Electrical Engineers. The authors first discuss the accuracy which may be attained. The great difficulty which is met with in the design of electrical instruments is the smallness of the forces dealt with. The greater the force for a given weight, the smaller will be the frictional error, but any attempt to increase the forces beyond a certain point is almost invariably accompanied by increased electric errors, quite apart from the question of excessive power consumption. The authors give a table of the electrical errors of various types of instruments (due to hysteresis, change of temperature, change of frequency, and stray fields). In a second table they give data on power consumption of various commercial types of instruments. They then discuss the general features of permanent-magnet, moving-coil ammeters and voltmeters; the chief source of error to be guarded against is the variation with time of the springs and magnet. The number of ampere-turns required in the moving coil varies in practice from ½ to 1 ampere-turn. Under these circumstances, for any given size of coil the necessary potential difference at its terminals is inversely proportional to the sectional area of the wire used. A limit is, however, soon reached; firstly, owing to the fact that a decreased resistance means an increased current, and with it the chance of contact resistance troubles, and secondly, owing to the resistance of the letting-in springs or strips. The best results are obtained when the resistances of the coil and springs are to one another in the inverse ratio of their temperature coefficients. A method for getting over the temperatures error, which is due to Campbell, is shown in Fig. 3, where *e* represents the moving coil, while the points *f* and *g* are connected to the shunt. The arms, *a* and *d*, are composed of copper; *b* and *c* of a material having a negligible temperature coefficient. If the resistance of *a*, *d* and *e* be 3 ohms each, while *b* and *c* have a resistance of 1 ohm each, practically perfect compensation will be obtained. The resistance having



FIGS. 3 AND 4.—DIRECT-READING SWITCHBOARD INSTRUMENT.

as large a negative coefficient as may be desired can be constructed as shown in Fig. 4. It consists of a thermometer tube, inside which is stretched a thin platinum wire. Any increase of temperature causes the mercury to expand, and hence to short-circuit more or less of the wire according to the dimensions of the apparatus. The authors point out that unless carefully shielded, moving coil instruments are contrary to the usual assumption, very considerably affected by stray magnetic fields. The ordinary cast-iron case appears to be quite an efficient shield for switchboard instruments. The authors then discuss moving-iron instruments. Almost all the errors to which they are liable, apart from those of a purely mechanical origin, are traceable to hysteresis in the iron. They remark that it is often assumed that an instrument whose indications are practically independent of frequency will also be independent of wave form and vice-versa. While this is true for all errors which depend purely on self-induction, it is far from being true when the errors arise from the iron itself. They then discuss magnetic shielding and damping. The paper is to be concluded.—Lond. *Elec.*, March 25.

Use of Condensers in Alternating-Current Measurements.—Peukert.—An article on the application of condensers for providing a lower e.m.f. at the terminals of an alternating-current instrument, when making measurements on a high-tension circuit. The author first discusses the case in which a number of condensers in series are connected across a line and the measuring instrument is connected to the terminals of one condenser. If all the condensers are identical then the voltage is reduced in proportion to the number of condensers employed. This method has been employed by the Allgem. Elek. Ges., in Berlin, and also in connection with the electrostatic voltmeters of Kelvin, Ayrton and Mather. Another method is to connect the measuring instrument in series with a condenser. To make the reading independent of the frequency, an air condenser should be used, since its capacity is independent of the frequency. The formulas for both cases are given.—*Elek. Zeit.*, March 24.

Universal Shunt.—An illustrated description of a universal shunt designed by Rymer-Jones, a diagram of which is given in Fig. 5.

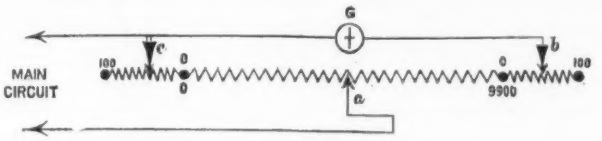


FIG. 5.—UNIVERSAL SHUNT.

The shunt is contained in a single box provided with two dials. The slide resistance coils on the left-hand dial consist of 99 coils of 100 ohms each, with one sliding contact arm, *a*, while, by way of vernier for slight alterations of the multiplying power of the shunt, there are, at both ends of these coils other extension resistances, each extension having a total resistance of 100 ohms. These extensions have each a separate sliding contact, both being actuated by the same handle, and so disposed that when one of these contact arms press on the zero stud the other arm is on its 100 stud. As the one contact moves from the zero towards 100 of its scale, the other moves from 100 towards 0 by equal distance. There is, therefore, always a total resistance of 10,000 ohms between the contacts, *b* and *c*, between which the galvanometer terminals are connected, while *a*

and *c* are in the main circuit. The vernier resistance studs, on which the marked contact arm presses, are arranged to give consecutive multiplying powers of 2, 3, 4, 5, 6, 7, 8, 9 and 10 ten-thousandths, after which the resistance is increased regularly by two ten-thousandths at a time. Thousandths and hundredths are read off the left-hand scale at *a* and tenths and units from the right-hand scale at *b*. The multiplying power of the shunt is the scale reading divided into 10,000; that is, the reciprocal of the scale reading, multiplied by 10,000.—Lond. *Elec. Rev.*, March 25.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—HETTINGER.—A preliminary paper on a new theory of wireless telegraphy. The author endeavors to base his theory not on that of the propagation of electromagnetic waves, but considering the problem like an ordinary problem of alternating-current engineering in closed circuits. The action of the vertical wires is represented in this theory by a self-inductance and capacity. Each vertical wire forms a condenser, C_{AT} with the earth, and the two vertical wires at the transmitting and receiving stations form together a capacity, C_{AA}, as indicated in Fig. 6. The coherer is represented as a condenser of high capacity in series with a resistance. The earth is introduced as a resistance and also forms the second plates of the two condensers, the first plates of which are represented by the two vertical wires. The author claims that in this way he is enabled to give a complete theory of the phenomena of wireless telegraphy on the basis of ordinary alternating-current engineering. —*L'Eclairage Elec.*, March 26.

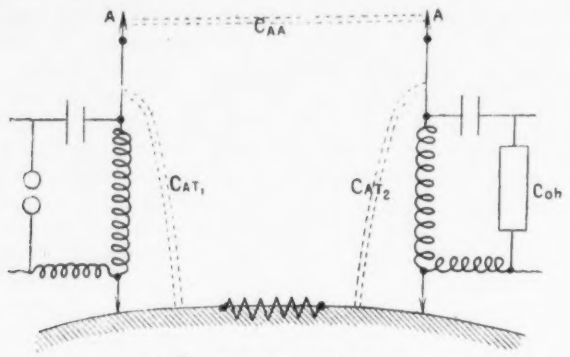


FIG. 6.—WIRELESS TELEGRAPHY.

MISCELLANEOUS.

Aluminothermic Preparation of Pure Metals.—GOLDSCHMIDT.—An article on the production of pure metals free from carbon by the aluminothermic method and on their applications for various metallurgical purposes. The preparation is carried out in a sort of crucible in which several hundred kilograms of metal are reduced in the single operation. On account of the great rapidity of reaction, the operation is completed in scarcely 30 minutes. The principle is to use equivalent quantities of oxide and aluminum. But in practice the great facility with which aluminum alloys itself makes it advisable to use somewhat more of the oxide and less of the aluminum than would correspond to a mixture in equivalent proportions. The author discusses especially the production and uses of chromium, manganese and molybdenum. While pure chromium free from carbon is specially useful for the production of special steels, the applications of pure manganese are rather in the copper, brass and nickel industries.—*Electrochem. Ind.*, April.

Diastoloscope.—CHARRIE.—A note on a new optical instrument of remarkable power, called the diastoloscope. "It is a kind of eye piece which is attached to a microscope in place of the ordinary eye piece. Instead of lenses, it contains two cones on the same axis. The field of view shows a central blank space surrounded by a ring, in which the object under examination appears considerably magnified, although distorted. The distortion does not interfere with the mapping out of hitherto undiscoverable detail. The author reproduces figures of diatoms showing considerable dilatation and detail, and expects to realize magnifications of 6,000 diameters."—*Comptes Rendus*, February 29; abstracted in Lond. *Elec.*, March 25.

REFERENCE.

Thawing Water Pipes by Electricity.—An article giving a summary of the results obtained with this method last winter in various cities, especially Newark, Ottawa and Ogdensburg.—*Eng. News*, March 17. (Several references to this application of electric current were published in ELECTRICAL WORLD AND ENGINEER recently.)

New Books.

THE STORY OF THE ATLANTIC CABLE. By Charles Bright. New York: D. Appleton & Co. 222 pages, 54 illustrations. Price, $1 net.

Mr. Bright has already written on the submarine cable in more voluminous form, but his larger volumes are not generally accessible to the American public. He now tells the story again very succinctly and well, and his book is a useful and desirable companion to that by Dr. Field, who may perhaps be said to have taken the American point of view. Aside from the historical portion, which is, of course, by no means new, though ever interesting as a narrative of a great achievement, there is much other matter of value, in handy condition. Mr. Bright gives details as to existing lines, tariffs, capitalization, etc. He states that the fifteen Atlantic cables now in existence represent $100,000,000, with a gross annual yield of $6,000,000. The reproduction of some of the old plates and portraits was a good idea. Mr. Bright's treatment of the subject is popular, and is intended for the general reader rather than in any sense for the technical student.

MODERNE GESICHKPUNKTE FÜR DEN ENTWURF ELEKTRISCHER MASCHINEN UND APPARATE (Modern points of view in the design of electrical machinery and apparatus). Dr. F. Niethammer, München and Berlin. 192 pages, 237 illustrations.

Dr. F. Niethammer, who is favorably known from his writings, has attempted in this book to go over the entire field of electrical apparatus, and to give suggestions as to their design and construction. He has studied very carefully the designs of the last few years, and, basing his judgment on a thorough theoretical knowledge, he has selected the best of what he found here and there, and offered it to the engineer in a condensed and comprehensive manner. The problem, which the author has attempted to solve is: Is it possible to build economical and efficient machinery for any desirable r.p.m. for any desirable capacity, for any practical and reasonable voltage and for operating conditions as they are actually found?

After a short introduction, in which the electrotechnics are rightly called the technics of high speed and "par excellence," the question of efficiency, losses, heating, ventilation, the present maximum voltages and the insulation are taken up in general. We regret to notice that, although American makes are referred to in several instances, in general the author has overlooked the great importance of local economical conditions, price of labor and material and the bearing they have upon the economy of the design and the method of construction. The frequently great differences between the designs of European and American manufacturing companies are often due just to these points.

When treating heating and ventilation, an attempt is made to use as a basis the formula,

$$T = C\,\frac{A}{O}, \text{ or } T = C\,\frac{A}{O\ (1 + .1\ v)}$$

where T refers to rise in temperature, A to losses, O to total external surface, v to surface speed, while C is a constant. The constant, C, has a wide range of variation and values of C are given for different constructions. The author has himself proven, however, that these constants are rather unsatisfactory, by saying that the results do not agree very well with the formula. On the other hand, he is in favor of artificial cooling, when the results do meet the expectations. Why do they? Because, when they are found differing from the calculation, the artificial means (amount of cooling water, air pressure, etc.) may be varied, until the guaranteed temperature is obtained. This is certainly a very convenient way of getting the desired temperatures. The engineer does not require infallible constants which substituted in a formula will give him accurate results for any case. The careful determination of the efficient radiating surface, and a careful heat run, will give sufficient data for obtaining the heating of different sizes of the same type.

The chapter on insulation is rather meagre, and as to the present state of this subject it is not modern at all. We learn very little as to the different kinds of insulating material; the author is still in the mica age. The effect of heat on the break-down of insulating materials is not taken into account. In order to test the insulation of different apparatus, the author gives some figures for overpotential test. These are rather low according to American demands,

and do not always express the endurance of the insulation. A heavy overload test is perhaps even more important for that purpose.

Electrical apparatus more particularly is taken up in the other chapters with a very keen eye and broad view. The reader will find many useful suggestions especially as to electromechanical construction. The best parts of the book are the chapters on polyphase generators and synchronous motors. The young designing engineer will find this book valuable, and the last pages give him some interesting advice and suggestions concerning shop practice, business organization, and the commercial part of engineering with many references to American practice, which the author seems greatly to admire.

BOOKS RECEIVED.

Die Metalle. By Dr. Bernhard Neumann. Halle: Wilhelm Knapp. 421 pages, illustrated. Price, 16 marks.

La Telegraphie Sans Fils. By Andre Broca. Paris: Gauthier-Villars. 234 pages, 52 illustrations. Price, 4 francs.

Les Chemins de fer Electriques. By Henri Marechal. Paris: Ch. Beranger. 556 pages, 516 illustrations.

Briquettes and Patent Fuel. By Philip R. Bjorling. London: Rebman, Limited. 254 pages, 121 illustrations. Price, $3.75.

Dynamomaschinen für Gleich und Wechselstrom. By Gisbert Kapp. Berlin: Julius Springer. 620 pages, 255 illustrations. Price,

Elektro-Akustische Untersuchnugen. By Robert Hartmann-Kempf. Frankfurt: Gebruder Knauer. 255 pages, 105 illustrations.

Die Elektrische Buhnen und Effekt-Beleuchtung. By Dr. Th. Weil. Leipzig: A. Hartleben. 256 pages, 205 illustrations. Price, 4 marks.

Wechselstromtechnik. By M. T. Zsakula. Leipzig: A. Hartleben. Four volumes. 264 + 216 + 200 + 200 pages, illustrated. Price per volume, 4 marks.

Essais Industriels des Machines Electriques et des Groupes Electrogenes. By F. Loppe. Paris: Gauthier-Villars. 280 pages, 129 illustrations. Price, 8 francs.

Compendium of Drawing. Chicago: By American School of Correspondence, Armour Institute of Technology. 410 + 477 pages, illustrated. Two volumes. Price, $3 per volume, $5 per set.

Practical Laws and Data on the Condensation of Steam in Covered and Bare Pipes. By Charles P. Spaulding. New York: D. Van Nostrand Company. 102 pages, illustrated. Price, $2.00.

Steam Turbine Power Plant for Boston Navy Yard.

An interesting departure in engineering practice by the authorities of the United States Navy, Department of Yards and Docks, is marked by the introduction of Westinghouse-Parsons steam turbines for furnishing power for lighting the buildings and yards, and power for operating dry dock pumps and miscellaneous machinery. The initial installation of this character is in process of construction at the Charlestown Navy Yard, Boston, Mass., and for the present one Westinghouse-Parsons turbine generating unit of 750-kw capacity will be placed in service. This turbine will be of the new short-barreled type and is now under construction at Pittsburg. A Worthington surface condenser will be employed, using salt water for circulation. The condensers will be located between the foundations, which consist of concrete piers. A running vacuum of 28 in. will be secured through the aid of a dry-air pump. Steam will be furnished at 150 pounds pressure by Babcock & Wilcox boilers in units of 350 hp, equipped with Roney mechanical stokers. Coil superheaters in the boiler settings will furnish to the turbine a superheat of about 100° F. The boiler house will be equipped with a complete outfit of coal and ash-handling machinery.

The present power plant is the outcome of an appropriation made in 1898 by Congress for a dry dock and pumping plant to be located at the Charlestown Navy Yard; the new plans for a dry dock equipment providing for a power plant located near the outer end of the new dock with piping connections to both old and new docks so that the one pumping plant would be able to handle them simultaneously or separately. During the period of construction of the new dock the Department of Yards & Docks at this Navy Yard underwent considerable enlargement necessitating an immediate increase in an electrical generating equipment for supplying light and power to buildings and departments.

In view of this situation, it was decided to supersede the dock pumping plant, originally provided for, by a central lighting, power and heating plant for the entire department, although retaining the dry dock pumping equipment which will now be electrically driven from the central station. It is also intended to supply from this plant electric light and power to the vessels docking which do not happen to be under steam. The power system as now under construction is, therefore, considerably more comprehensive than originally laid out.

The turbine plant will supply three-phase alternating current at 2,300 volts, this voltage being used for general distribution and for direct use in large motors, while for lighting lower voltage will be provided by transformation. The turbine generator will be served by a 37½-kw Westinghouse compound exciter unit.

The engineering work is under joint execution by the Department of Yards and Docks and the constructing engineers, Westinghouse, Church, Kerr & Co., who are installing the plant.

Wireless Telegraphy in the War.

During the recent demonstration of the De Forest wireless telegraph before the British Post Office between Holyhead, England, and Howth, Ireland, arrangements were made by the De Forest Company with the *Times*, of London, and Captain Lionel James, its famous war correspondent, then about to start for Yokohama. This contract demanded that two complete sets of wireless telegraph apparatus, manned by two expert operators, should be shipped to the front. Within ten days the full outfits, including even two kerosene oil engines, and weighing all told over four tons, were shipped express to Vancouver, where the men just caught the steamship *Empress of Japan*. At Shanghai, China, Captain James had chartered the little steamer *Hai-num*, a two-master, on which topmasts were rigged to the height of 75 ft., all the vessel could safely carry. There the apparatus was transferred, and during the voyage north to Wei-Hai-Wei the two experts, Athearn and Brown, both New Yorkers, worked unceasingly until the ship's set was completely installed and in operation.

Capt. James' lieutenant, Mr. Fraser, had preceded him to Wei-Hai-Wei, and there the men found nearly complete a bamboo mast 180 ft. high, rigged in the best possible fashion, considering the unsatisfactory wood which alone could be obtained for that purpose, and the great dearth of necessary supplies. A pair of rough bungalows were thrown together by coolie labor, and the task was begun of moving the engine and heavy machinery from the dock to the promontory where stands the station. This point is some ten miles east of the town of Wei-Hai-Wei, accessible only by pony messenger, over a narrow and rocky trail. The utmost energy and ingenuity was required on the part of the English and Americans to get the Wei-Hai-Wei apparatus quickly installed. The fact that just three weeks from the date of landing at Wei-Hai-Wei, the *Times* printed a column-long dispatch from Capt. James, received by wireless is a tribute to the spirit and ability which is so characteristic of that correspondent and his staff. Since that time numberless dispatches have been flashed from the masts of the little *Hai-mun*, far out in the Corean Gulf, near Chemulpo, or even in company with the Japanese fleet in battle off Port Arthur.

Each set is of 1-kw capacity and comprises a 2½-hp Secor oil engine, a 60-cycle, 500-volt generator with separate exciter, oil transformer delivering 20,000 volts, oil transmitter key, regular Shoemaker-De Forest oscillator and syntonizer, electrolytic receiver, with relay and bell attachment and highly sensitive telephone receivers. The *Hai-mun* being without electric power, carried an oil engine, the same as the shore station.

It was the original intention to install one station upon one of the Sir James Islands in the Chemulpo peninsula and transmit thence to Wei-Hai-Wei, a distance of 175 miles, but Capt. James decided that an installation upon a boat would give him greater mobility and save long delays in getting dispatches to the transmitting station.

The De Forest apparatus in the Yellow Sea has not been exempt from serious competition by the Japanese wireless stations on board their vessels of war. Whether intentionally to interfere or in the ordinary operation of their stations there has been a continuous stream of wireless signals in that neighborhood, but the methods of syntonization employed in the De Forest apparatus, the speed with

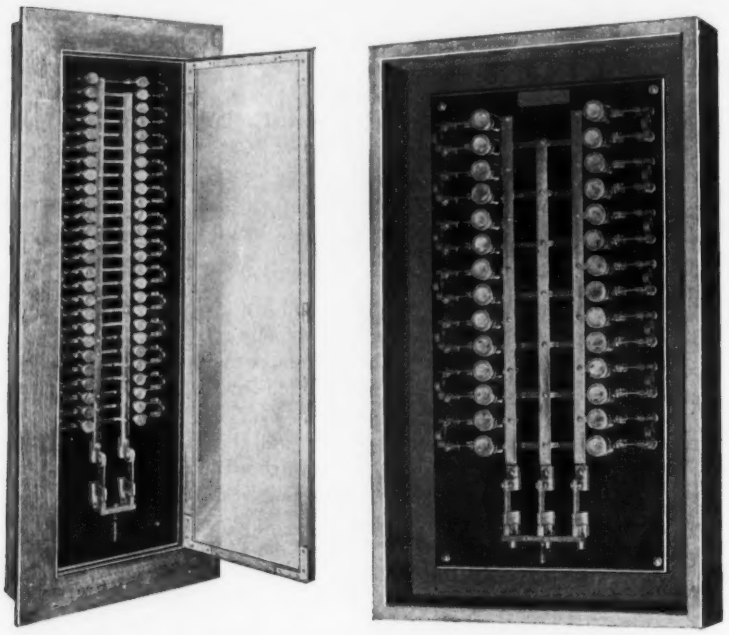
which the press dispatches are rushed through with the alternating-current transmitter—25 to 30 words per minute—(which greatly exceeds the speed of the Japanese system) together with the telephonic method of sound reading, have, it is said, enabled the American operators to send the longest wireless dispatches on record, without error or delay.

Barring an accident to the receiving mast on the Wei-Hai-Wei Peninsula from a typhoon, the *Times* news service by De Forest wireless system has been uninterrupted.

Capt. James' dispatches form a series of masterly and graphic pen pictures of the war, standing alone amid the mass of mutilated, conflicting reports which have come from the seat of conflict.

Fuse Plug Cabinet Panels.

The line of cabinet panels manufactured by the General Electric Company has been received with favor by contractors and architects throughout the country. These panels are furnished for 125 and 250-volt service, in a variety of arrangements and circuits. The distinctive feature is the employment of the Edison fuse plugs on the different circuits. The plug type of panel is considered to have an advantage over the cartridge fuse type in that the bus-bars and connections are placed considerably below the level of the tops of the plugs, thus rendering very remote the liability of a short-circuit. The fuse plugs furnished with the 125-volt panels are fitted with a mica cap, which enables one at a glance to know on what circuit the fuses

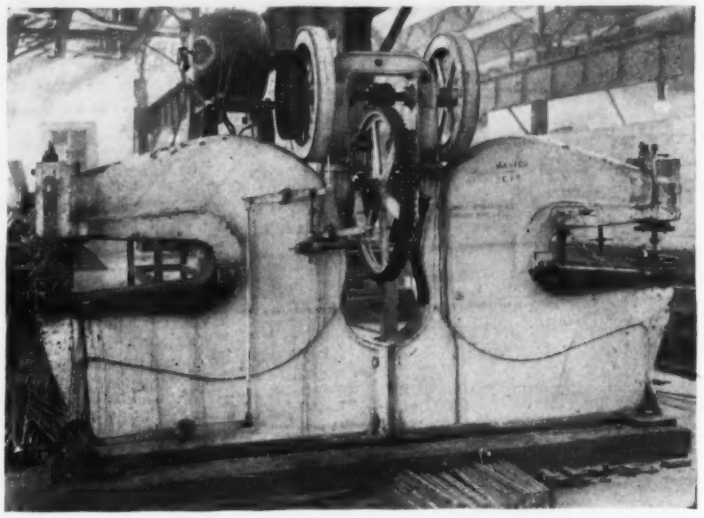


FIGS. 1 AND 2.—CABINET PANELS.

have blown. The 250-volt panels are fitted with a reloadable type of fuse plug easily inserted, without danger of shock. These panels are neat in appearance, compact and well finished; and owing to the nature of the Edison plug no injury to the panel itself can take place when the fuses blow. Fig. 1 shows a cabinet panel for 26 two-wire, double-branch circuits from two-wire mains with main and circuit switches, while Fig. 2 shows a somewhat smaller panel arranged for 14 two-wire, single-branch circuits from three-wire mains with main and circuit switches. The spacing of the different panels is in conformity with the results of the National Board of Fire Underwriters.

Punch and Shear Motor-Driven.

In the busy shops of the Charlestown Navy Yard are found many instances of the effectiveness of motor-drive as applied to punching and shearing machinery. The character of the work done is such as to subject the motors to very severe conditions of load and in every case they have answered all the demands made upon them. The accompanying half-tone shows a Long & Allstatter Company double punch and shear driven by a Crocker-Wheeler semi-enclosed 2-hp motor, wound for a pressure of 220 volts and a speed of 975 r.p.m. The machine does work up to punching a ½-in. hole in ½-in. iron, 35 strokes to the minute, or shearing a 1-in. round or a 3 x ½-in. flat bar. It will receive punching tools, or cross-cut or splitting shears. This type of machine is built with a throat from 4 to 30 in. in depth. The respective sides of the double machines are entirely independent, so that one side may be run while the other is idle or



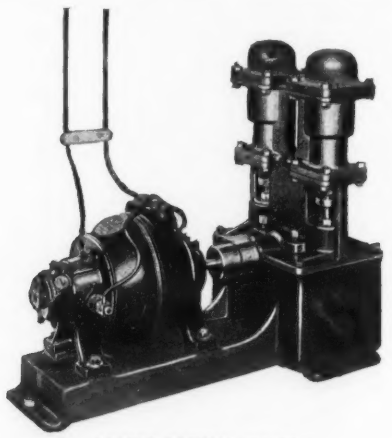
MOTOR-DRIVEN PUNCH AND SHEAR.

both may be operated at the same time. There is an automatic stop which may be used to arrest the slide at any point in the stroke.

The simplicity of attachment and convenience in operation of this motor-drive equipment is evident. It means a rapidity of control and a saving in floor space and permits a flexibility of shop arrangement, with respect to light, etc., that is out of the question with the old method of shaft and belting.

Direct Connected Electric Pump.

The engraving herewith illustrates an improved type of direct-connected electric pump for supplying tanks with water in office buildings, apartment houses, hotels and residents. The makers claim for it high efficiency, simplicity and durability. By a special switch



MOTOR-DRIVEN PUMP.

the apparatus operates automatically and starts pumping when the water in the tank is low, stopping when the tank is full.

The pump requires no foundation and can give service for months without attention. There are no oil cups, nor places to use a squirt can, lubrication being automatic. The outfit consists of an electric motor driving a duplex double-acting brass pump through a speed-reducing device which consists of a worm and gear running in a closed bath of oil. It is noiseless and by reason of its compactness and few parts is very reasonable in price. The space occupied is, length, 30 in.; height, 27 in.; width, 15 in. It was designed by Mr. Milan W. Hall, a pioneer in this line of work, and Mr. Charles S. Pease, of 13 Dutch Street, New York City, who is well known in the electrical and mechanical field, is general agent.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Stock prices were firmer as a rule and showed considerable strength, notwithstanding the renewal of litigation in the Northern Securities matter. Support was given to prices by large interests and a favorable effect was produced by the declaration of the regular dividend on United States Steel preferred. There was little movement in the industrial list as a whole, although amalgamated Copper was supported moderately. In the Curb market the volume of business was larger and prices are generally higher, the heaviest operations being in copper shares. The rise in the latter was based on improved trade conditions. Among the declines are noted Otis Elevator, Interborough Rapid Transit and New Orleans Railway preferred. In the electric and traction stocks on the regular exchange there was no particular influence at work, and each stock fluctuated independently of all others. Allis-Chalmers common closed with a net loss of ½ point, while the preferred gained 3 points net, the closing prices being 7⅛ and 43 respectively. General Electric lost 1 point and Westinghouse gained 3½, the former closing at 163⅝ and the latter at 162½. These two stocks, it will be noticed, are just now nearly alike in price. Brooklyn Rapid Transit closed at 46⅛, this being a gain of 2 points, and Metropolitan Street Railway, 117, a gain of 5⅛. Western Union made a net gain of ½, closing at 89, and American Telephone and Telegraph lost 1¼, closing at 123. Following are the closing quotations of April 12:

NEW YORK.

	Apl. 5	Apl. 12		Apl. 5	Apl. 12
Allis-Chalmers Co.	7⅛	7¼	Electric Vehicle	7¼	7
Allis-Chalmers Co. pfd.	43	40	Electric Vehicle pfd.	10	10
American Tel. & Cable	85	84	General Electric	163	164
American Tel. & Tel.	126	126⅛	Hudson River Tel.	..	..
American Dist. Tel	23	23	Metropolitan St. Ry.	111¾	115¼
Brooklyn Rapid Transit	44¼	46⅝	N. Y. & N. J. Tel.	..	..
Commercial Cable	170	165	Marconi Tel.	..	..
Electric Boat	20	20	Western Union Tel.	88¼	88¾
Electric Boat pfd	50	50	Westinghouse com.	160	160
Electric Lead Reduction	¾	¾	Westinghouse pfd.	175	175

BOSTON.

	Apl. 5	Apl. 12		Apl. 5	Apl. 12
American Tel. & Tel	126	126⅛	Western Tel. & Tel. pfd.	80	80
Cumberland Telephone	113	113	Mexican Telephone	1¼	1⅛
Edison Elec. Illum.	225⅛	237⅛	New England Telephone	120	121
General Electric	163	..	Mass. Elec. Ry.	19	20¼
Western Tel. & Tel	8	8	Mass. Elec. Ry. pfd.	74	75

PHILADELPHIA.

	Apl. 5	Apl. 12		Apl. 5	Apl. 12
American Railways	43	43	Phila. Traction	95½	96
Elec. Storage Battery	56	57	Phila. Electric	5¾	5¾
Elec. Storage Battery pfd.	56	57	Phila. Rapid Trans.	13¾	13¾
Elec. Co. of America	8	8			

CHICAGO.

	Apl. 5	Apl. 12		Apl. 5	Apl. 12
Central Union Tel.	..	..	National Carbon pfd.	..	100
Chicago Edison	..	150	Metropolitan Elev. com.	..	15
Chicago City Ry	..	160	Union Traction	..	5⅛
Chicago Tel. Co.	..	..	Union Traction pfd.	..	30½
National Carbon	..	28			

*Asked

NEBRASKA TELEPHONE REPORT.—The Nebraska (Bell) Telephone Company reports as follows for the year ended December 31, 1903:

	1903.	1902.	1901.
Gross	$1,049,907	$905,660	$754,971
Expenses	857,310	737,220	617,345
Net	$192,597	$168,440	$137,626
Dividends	115,768	99,000	81,222
Surplus	$76,829	$69,440	$56,404

The general balance sheet is given below:

Assets:			
Construction	$2,238,974	$2,039,603	$1,674,796
Supply department	144,738	73,027	67,372
Real estate	192,547	158,910	141,317
Stock and bonds	1,867	2,100	100
Accounts and bills received	285,136	141,480	39,005
Cash	45,568	33,025	38,192
Total	$2,908,830	$2,448,145	$1,960,782
Liabilities:			
Capital stock	$2,196,900	$1,800,000	$1,500,000
Surplus	211,029	334,201	214,760
Reserve	400,237	239,672	218,779
Bills and accounts pay	100,664	74,272	27,243
Total	$2,908,830	$2,448,145	$1,960,782

LIGHTING IN CALIFORNIA.—The California Gas & Electric Corporation has consummated an important deal by the purchase of the systems of the Standard Electric Company, of California, and the United Gas & Electric Company, a monopoly in the supplying of electric power to twenty of the principal countries of the State. The Standard has a capitalization of $5,000,000 authorized stock and $5,000,000 in bonds, all issued and outstanding. The United Gas & Electric Company was capitalized at $2,500,000 in authorized stock, of which $2,286,000 is outstanding, and has $2,000,000 in authorized bonds, of which $1,100,000 is outstanding. The price paid for the two companies has not been made public, but it is said to be a high one. The Standard Electric Company's main plant is in Amador County. It supplies Sacramento and San Joaquin Counties, joining with the United Gas & Electric Company in supplying the counties around San Francisco Bay, its lines running through San José up the west side of the bay, into this city. Details and illustrations of the Standard system have been given in the pages of ELECTRICAL WORLD AND ENGINEER.

ELECTRIC SUPPLY COMPANY, of Savannah, Ga., has recently been incorporated for the purpose of extending its wholesale department and to add an automobile department, which has been accomplished. The paid in capital is now $25,000 and the prospects are exceptionally bright. Its sales extend over four Southern States, and the construction department is crowded with a number of large contracts. Among them is the lighting plant for Sandersville, Ga. The officers are as follows: David Wesson, of the Cotton Oil Company, president; Ed. M. Wilson, vice-president; Joseph S. Walker, treasurer and manager; E. C. Richardson, secretary. The board of directors is composed of wealthy and representative business men of this city. Among them are the following: W. V. Davis, treasurer Savannah Trust Company; Harvey Granger, of Granger Stubbs Lumber Company; William Kehoe, of Kehoe Iron Works; H. H. Bruen, of Patterson & Downing Co.; E. Moyle, merchant and capitalist; Capt. W. B. Stephens, a wealthy attorney, and others.

INDIANAPOLIS TRACTION TERMINAL.—The Indianapolis Traction and Terminal Company gross earnings increased $167,000 for the year ended December 31, 1903, over those of the constituent companies for the preceding year, and the months of January and February, 1904, each show an increase of about $10,000. The guarantee on the $5,000,000 Indianapolis Street Railway stocks is now 4 per cent. per annum, or $200,000, an increase of 1 per cent. over 1903, and rises 1 per cent. per annum up to 6 per cent. in 1900. A substantial surplus over the guarantee is stated as being earned and the proceeds of $3,000,000 5 per cent. bonds sold by the Terminal Company, which issue is a first lien on the terminal property, has correspondingly improved the position of the Indianapolis Street Railway 4s ahead of them.

CENTRAL AND SOUTH AMERICAN TELEGRAPH.—The annual report of the Central and South American Telegraph Company for the year ended December 31, 1903, shows as follows:

	1903.	1902.	Changes.
Gross	$1,072,134	$1,002,572	Inc. $69,562
Op. exp.	405,296	388,031	Inc. 17,265
Net	$666,838	$614,541	Inc. $52,297

There was expended from net earnings $62,710 for cable used in repairs and improvements, leaving a surplus after 6 per cent. dividends ($463,536) of $140,592. The total surplus December 31, 1903, was $820,912.

ATLANTIC COAST ELECTRIC.—Mr. James Smith, Jr., receiver of the Atlantic Coast Electric Railroad Company, has filed his report in the United States Circuit Court at Trenton, N. J., showing that the road is in good physical condition and capable of first-class operation. The report shows that the receipts for the year ending January 31, 1904, were $309,530, disbursements $262,064, leaving a balance of money on hand at the date of the report of $47,456. The report further shows that there were 4,048,671 passengers carried in the year.

BIRMINGHAM, ALA., BONDS.—The Birmingham, Ala., Railway, Light and Power Company has voted for an issue of $10,000,000 of 4½ per cent. bonds, with the proceeds of which it will take up the present $6,000,000 of 5 per cent. bonds, leaving a treasury surplus of $3,400,000 for the making of betterments to local properties. Holders of the present bonds will exchange bond for bond into the new issue and receive a bonus of $100 on each $1,000 bond besides. The project was launched with practically unanimous vote.

GEORGIA RAILWAY AND LIGHTING COMPANY, of Atlanta shows a gross for nine months ending December 31, 1903, of $1,424,286, a net of $605,860, and a surplus after all payments and deductions of $228,914.

BELL TELEPHONE BOND NOTES.—Speyer & Co., and Lee, Higginson & Co. have purchased from the American Telephone and Telegraph Company $20,000,000 5 per cent. 3-year secured gold coupon notes, to be dated May 1, 1904. The notes are secured by $25,000,000 of the company's present 4 per cent. bonds. The notes cannot probably be delivered before May 10. The $20,000,000 American Telephone notes are going very rapidly. Only a limited amount will be offered at the present price of 99 and interest, which is equivalent to a 5.33 per cent. basis. These notes are being offered in London, Paris, Berlin and Frankfort, and a large number of them are expected to be sold in these cities. The American Telephone and Telegraph Company had a number of offers from different syndicates, some of which were for bonds and some for notes, but the company showed its confidence in easier monetary conditions in the future by issuing 3-year 5 per cent. notes instead of a long-term bond. Although the payment for the entire amount will not be required of the syndicate at once, a good proportion of it will be paid immediately, and the syndicate has the privilege of anticipating the balance. The disappointed bond houses say that the price paid by the syndicate, which is comprised solely of Lee, Higginson & Co. and Speyer & Co., was 97½.

ELECTRIC COMPANY OF AMERICA.—The Electric Company of America net earnings for the fiscal year ending December 31, 1903, roundly $398,000, represent the amount applicable to pay the 6 per cent. dividend, requiring only about $240,000 per annum. It is understood that most of the $400,000 cash which the company had at the beginning of 1903 has been reinvested, the company having purchased small plants in the Middle West during the year. In 1902 interest on the cash loaned out and in bank constituted about $25,000 of other income, but except for a small item of "other income," the income in 1902 is entirely from operation of plants. The amount of dividends and interest received by the company, as the holding company, from the stocks and bonds of the subsidiary local lighting companies, is understood to be around $430,000. The corresponding income in 1902 was $366,587. The net earnings applicable to the dividend was $352,478. The company shows ordinarily between $300,000 and $400,000 bills receivable, against current liabilities of a few thousands dollars only.

NEW YORK TRANSPORTATION.—President Sanderson, of the New York Transportation Company, stated at the annual meeting last week that the company has about $750,000 in bank. About $300,000 has been spent in new construction, principally in connection with establishing the express business. The earnings from the express business so far have been somewhat disappointing, while the earnings from the vehicle department are increasing. Those who are familiar with the company's affairs point out that the franchises are worth more than the par value of the outstanding stock. The hard winter has unfavorably affected profits. The following directors were re-elected: Henry Sanderson, Harry Payne Whitney, Philip P. Dodge, George H. Day, G. Herbert Condict, George W. Wesley and William H. Palmer, Jr. The New York Transportation Company is capitalized at $5,000,000. It operates the Fifth Avenue stage line and a large electric automobile business.

CROCKER-WHEELER COMPANY INCREASES ITS CAPITAL.—A doubling of its capital stock, which has been $1,000,000, is announced by Crocker-Wheeler Company, of Ampere, N. J. The company, which is the largest of the independent electrical manufacturers of dynamos, motors, etc., was organized in 1892 by Dr. Schuyler Skaats Wheeler and Prof. Francis B. Crocker, on a relatively modest basis. It now has fifteen branch offices from Boston to San Francisco and does one of the largest businesses in the world in electric power apparatus. The capitalization was several times increased until in 1899 it had become $1,000,000. In view of the rapidly expanding business the stockholders have now decided to increase this amount to $2,000,000. The excellent balance sheet for last year was given in this department recently.

INCANDESCENT LAMP COMBINATION.—It would appear that in addition to those licensed to manufacture incandescent lamps under the General Electric patents in accordance with the recent pooling arrangement on prices, etc., are the Tipless Lamp Company, 316 Hudson Street, New York, and Monarch Electric Manufacturing Company, Warren, Ohio. So far as known, the following concerns have not applied for a license: American Incandescent Lamp Company, Kentucky Electrical Company, Germania Electric Lamp Company, Missouri American Electric Company, Moline Incandescent Lamp Company, and the Sawyer-Man Co., as already announced.

KEYSTONE TELEPHONE COMPANY, of Philadelphia, reports for the March quarter a net of $78,910, a gain over the corresponding period last year of $37,592.

DIVIDEND.—The Twin City Rapid Transit directors have declared a quarterly dividend of 1¼ per cent. upon the common stock, payable May 16.

Commercial Intelligence.

THE WEEK IN TRADE.—With the advent of more spring-like weather trade has received new life, and for the most part events have been favorable. The better weather conditions have increased retail distribution in the cities and helped farmers in their planting preparations. Wholesale and jobbing distribution have been strengthened in tone rather than in volume by the more favorable weather and the resumption of out-door work is helping distribution of iron and steel. The soft coal industry has also improved, owing to the removal of the fear of a general strike of miners. Collections, however, do not yet reflect any improvement in trade conditions, being especially backward in some sections of the Middle West, where recent floods have caused damage. *Bradstreet's* states that trade activity for this year's first quarter is behind that of the corresponding period last year. Failures exceed those of 1903 by 8 per cent. in number, though 5 per cent. less than those in 1902. Liabilities exceed those of a year ago by 70 per cent., and, owing to bank suspensions, are the heaviest since 1897. There were 201 business failures for the week ending April 7, as against 212 the week previous, and 163 the corresponding week in 1903. It is pointed out that the general level of prices in March for 8 out of 13 classes of products, including bread stuffs, meats, textiles, hides and leather and building materials, fell off about 1 per cent. for the month, but is still in excess of a year ago at this time, and near the highest for four years. The iron trade appears to be cheerful. Finished products are in moderate demand at leading markets. Among the other metals copper is firmer. Large producers have started an upward movement in prices based upon the recent heavy exportation and not upon any increase in demand here. Business, however, still lags. Quotations are 13⅛ @ 13⅜ c. for Lake; 13⅛ @ 13¼ c. for electrolytic and 12⅞ @ 13⅛ c. for casting stock.

EXTENSIVE PLANT FOR SILVERSMITH SHOPS.—The new plant now under construction by Dominick & Haff, silversmiths, at 543 West Twenty-third Street, New York, is to be installed with one of the most extensive electrical equipments hitherto utilized in the manufacture of silverware. The Crocker-Wheeler Company, through its New York office, 39-41 Cortlandt street, has secured the contract. There will be one 150-hp and one 50-hp engine type, 260 r.p.m., 250-volt generators direct connected to engines of 225-hp and 75-hp capacity, respectively, built by the Ames Iron Works. The motor installation will consist of 56 machines. There will be 37 constant speed motors and accessories and 18 variable speed machines. The latter will be of multiple voltage, which is to be furnished by a three-unit balancing transformer. The motors will range in capacity from ¼ hp to 30 hp. The average capacity will be 7½ hp. Most of the machines will be individual drive. They will be used for operating blanking presses, embossing presses, drop hammers, metal rollers and lathes.

THE CHIPMAN ELECTRIC PURIFYING COMPANY, of 13 Park Row, New York, and Schofield Building, Cleveland, Ohio, have appointed Col. W. S. Rogers manager of their Western office in Cleveland. This department includes all of the territory west of Pennsylvania. The Chipman process contemplates not only the purification of water under pressure for steam boilers, but has been worked out for municipal work in clarifying and purifying water for towns and cities. Plans are now being drawn up for a plant to furnish thirty million gallons per day for the city of Montreal. Mr. Rogers is well known as one of the pioneers of the arc lighting industry, having been in the old Brush Electric Company for 15 years. He has been watching the purification of water for electricity for some time, and has made up his mind that it is as far ahead of sand filtration as electric cars are of cable and horse cars.

EQUIPMENT FOR ATLANTA TERMINAL RAILWAY DEPOT.—The new Atlanta (Ga.) Terminal Railway depot is to be equipped with considerable plant for light and power purposes. Through the Atlanta office of the Harrisburg (Pa.) Foundry and Machine Works which is under the management of Glenny & Castanedo, two 150-hp and one 225-hp engines have been contracted for. The first engine will be direct connected to Westinghouse generators of 100 kw capacity each. The other engine will be direct connected to a 150-kw Westinghouse generator.

EQUIPMENT FOR MEXICAN MINES.—The San Felipe Mining Company, whose headquarters are in Philadelphia, and of which Colonel N. Z. Seitz is vice-president and general manager, is about to install an electric plant for the purpose of driving the mill drills, etc., on its mining properties located in the Ixtlan district, State of Jalisco, Mexico. Power will be derived from a hydraulic plant to be erected in the vicinity of the mines.

PELTON WATER WHEELS.—There are now running something more than 11,000 Pelton wheels in various parts of the world, in connection with electric transmission, mining, manufacturing and other industries, aggregating in excess of 1,000,000 hp. In the United States there are: California, Oregon and Navada, 7,647 wheels, 708,370 hp; Washington, Idaho and Alaska, 623 wheels, 58,225 hp; Utah, Colorado and Montana, 176 wheels, 24,970 hp; Hawaii, New Mexico and Arizona, 208 wheels, 13,800 hp; Middle, West and Atlantic States, 146 wheels, 5,670 hp. In foreign countries there are: Mexico and Central America, 636 wheels, 152,905 hp; various South American States, 371 wheels, 24,660 hp; Australia, Japan and India, 484 wheels, 40,250 hp; East and West India Islands, 243 wheels, 30,250 hp; British Columbia and Nova Scotia, 52 wheels, 10,500 hp; England and South Africa, 77 wheels, 12,220 hp; Germany, France, Italy and Spain, 341 wheels, 4,820 hp; Norway, Sweden and Denmark, 36 wheels, 2,800 hp. The total is 11,040 wheels, 1,089,440 hp. Results in excess of 80 per cent. efficiency are reported by the Gold Stream plant of the British Columbia Electric Railway at Victoria, B. C. So well satisfied is this company that it has given the Pelton Company another contract to increase the output of the plant. This additional installation will consist of a water wheel unit for direct connection to a 1,000-kw, 400-r.p.m. Canadian-Westinghouse generator. This unit will consist of two wheels fitted with the latest type of Pelton buckets and needle nozzles both with pilot control, to operate under an effective head of 600 ft. The wheels will be mounted one on each end of the main shaft, which will be carried on ring, oiling, ball and socket generator type bearings. The wheels will be completely enclosed in sheet steel housings, mounted on heavy bed plates, designed also to carry the armature of the generator, thus making a complete iron-mounted integral unit with the Westinghouse engine type generator. This will give considerable reserve capacity to the plant which has been operating most successfully for a number of years.

THEATRE STEEL CURTAINS.—The Iroquois Theatre disaster in Chicago has led to some radical improvements in theatre drop curtains. Mr. Emery Stanford Hall, consulting architect for seven Chicago theatres, has placed in the Academy of Music a curtain of his own design and has awarded contracts for the placing of similar curtains in the Bijou, Alhambra and Haymarket theatres to the Sykes Steel Roofing Company. It is Mr. Hall's belief that it is dangerous rather than safe to use a very heavy gauge steel in the curtains, as was shown by accidents in "sticking." Mr. Hall's curtains weigh about 2 tons each, according to the size of the arch, and are made from 24-gauge black corrugated sheets protected on the stage side by asbestos. This curtain has no side bearings, but is under tension at all times between upper and lower cables, which hold it in place. Those from which it is hung are carried over pulleys high above the stage and support heavy counterweights in the basement, which keep them taut, also allowing for expansion and contraction. Under ordinary circumstances the curtain is raised by a motor connected through a worm gear with the drum around which the cables pass, but in case the motor should get out of order, by pulling a controlling rope attached to the lever of the drum the latter is disengaged from the motor and the curtain can be raised by hand. An electric button is placed on every fly floor and also at a point in the house, each button having the right of way over the rest of the machinery, so that by touching it the curtain may be instantly lowered. The lowering is effected by counterbalancing weights which weigh 200 pounds less than the curtain, allowing for friction and permitting it to fall by its own weight without shock to the stage floor. The motor which raises the curtain runs at four speeds and is controlled by switches in the flies.

MEXICAN LIGHT AND POWER PROJECTS.—A number of projects are being considered at present for the construction of electric lighting and power plants in various parts of Mexico. Steps have been taken by the municipal authorities of Lagos, a city of 20,000 population in the State of Jalisco, for the installation of a light and power system. At Real del Monte, which has about 4,000 inhabitants in the State of Hidalgo, a plant is also to be built. The State government has contributed $3,500 towards the undertaking. Longinos Gonzales, of Tescaltiche, State of Jalisco, population about 10,000, has filed an application with the State authorities requesting the necessary permission to establish a light and power plant. Power will in this instance be generated by steam. Zacatlan, a city of some 25,000 people, State of Puebla, is to have a municipal light and power system. Plans have already been drawn up by the city council for submission to the State government for approval. The Compania Maustral de Guadalajara, which operates a 2,000-hp hydraulic plant at Las Juntas for the purpose of transmitting current to Guadalajara for lighting purposes chiefly, is about to let contracts for 2,000 hp additional equipment.

PLANT FOR CEMENT WORKS.—The extensive improvements contemplated by the Phoenix Cement Company, Nazareth, Pa., have all been laid out by Dodge & Day, modernizing and contracting engineers, Nicetown, Philadelphia, Pa., and it is thought the work will be started in the near future. Most of the buildings will be enlarged, electrical transmission used throughout, and the entire plant thoroughly modernized in order to materially increase the output to keep pace with the growing demand for the Cement Company's product. This will necessitate the installation of considerable additional power equipment, as well as a 200-kw generator, tandem compound engine for generator, one 50 and one 75-hp motor, as well as a number of smaller motors; charging cars, turntable, coal and ashes conveyor, underfeed stokers, steam locomotive for hauling cars to and from the quarries; electric hoist, electric air compressor, blower and exhauster, air-cooling conveyors, elevators, automatic weighing machine, extension of the track system, etc.

A 1,500 KW. CURTIS FOR LONG ISLAND PLANT.—The Nassau Light and Power Company, which furnished power to Roslyn, Mineola, Hempstead, Seacliffe, Port Washington, Floral Park and several other Long Island villages, is to remove its plant from the first mentioned place to the water side at Glenwood, about four miles distant, which location will permit of a cheaper coal supply and better facilities for condensation. The rearrangement and enlargement of the condensing equipment has been entrusted to the Worthington branch of the International Steam Pump Company, 114 Liberty Street, New York. Two 400-kw Westinghouse turbines which are already installed at Roslyn will be transferred to the Glenwood plant, and additional equipment consisting of a 1,500-kw Curtis turbine has been contracted for. The transformers, switchboard, etc., have been ordered from the General Electric Company. Mr. C. O. Mailloux is acting as consulting engineer for the Nassau Company.

GOULD STORAGE BATTERY CONTRACTS.—The Gould Storage Battery Company, Astor Court Building, New York City, reports that among recent contracts closed by the company, are the following: Chambersburg, Greencastle and Wynesboro Railway, Waynesboro, Pa., two floating batteries, one of 242 cells, and one of 244 cells. Additional plates for Lexington Street Railway Company, Lexington, Ky., increasing the present output to 352 kw. Elder & Johnson, Dayton, Ohio, 60 cells of 400 amp. discharge, with Gould c.e.m.f. booster, for elevator regulation in Rebold Building. Bank of Montreal, Montreal, Can., 61 cells with a discharge of 960 amp., with motor driven end cell switch. Isolated and residential plants for C. C. Williams, Cohassett, Mass.; W. T. Smith, Elka, Nev.; United States Navy, Navy Yard, New York. Also six central battery system telephone plants at different places.

ALLIS-CHALMERS FOUNDRY PURCHASE.—The Bollmann-Wilson Company's foundry plant at Norwood, Cincinnati, has been sold to the Allis-Chalmers Company, through the Bullock Electric Manufacturing Company, of Ohio. The foundry was established by Hoefinghoff & Lane at the request of the Bullock Company, which stated that it would take all the castings that the foundry would turn out. This purchase will give the Allis-Chalmers Company a modern equipped foundry, a shop with an area of 40,000 sq. ft. and six acres of land. The property lies across the street from the Bullock plant on Forest Avenue. It is the intention to improve the property and make additions. Besides the castings that will be needed for Bullock products there will be manufactured castings for Allis-Chalmers manufactures.

LIGHTING EQUIPMENT FOR SAN REGIS HOTEL.—More lighting equipment will be ordered shortly for installation in the new San Regis at Fifty-fifth Street and Fifth Avenue, New York. The machinery contracted for last year is capable of developing 1,000 kw. It consists of two 450-hp and the same number of 300-hp Harrisburg four-valve engines direct connected to Western Electric Company generators of 300-kw and 200 kw capacity respectively. The additional equipment will comprise a 300-kw lighting set. The contract will be awarded through Trowbridge & Livingston, 424 Fifth Avenue, the architects of the hotel.

THE INTERNATIONAL TELEPHONE MANUFACTURING CO., Chicago, have recently installed a complete inter-communicating system in the City Hall, Chicago. Each station is provided with an "International" desk set with long-distance transmitter, double pole receiver, and metallic jack plug-switch, enabling any one station being called directly from any of the others in the system. Any number of pair of instruments may be used simultaneously without interference.

TO ELECTRICALLY OPERATE OAXACA MINES.—Mexican advices state that application has been made to the fomento department by Don Manuel M. Mimiago y Camacho for a concession to utilize the waters of the Rio Atoyac in the State of Oaxaca, between the districts of Ocotlan and Ejutla. A large hydraulic plant is intended to be constructed. The current will be used for operating various mining plants in these districts.

EQUIPMENT FOR CANTON MANUFACTURING PLANT.—Parlin & Orindorff, the large agricultural implement manufacturers, of Canton, Ohio, are about to increase their power plant. An additional 500-hp equipment—one unit—will be installed.

General News.

THE TELEPHONE.

NEW DECATUR, ALA.—The franchises in this place of the Southern Bell Telephone Company, the American Telephone and Telegraph Company and the American Telephone and Telegraph Company of Alabama, have been revoked. The Morgan County Telephone Company is now in sole possession of the field. It is expected that the three first named companies will apply for an injunction against the city.

REDDING, CAL.—The Redding, Ingot & Wengler Telephone Company has been incorporated here with a capital stock of $10,000.

RED BLUFF, CAL.—The Balls Ferry Telephone Company is being organized by L. D. Cheeney, D. L. Gover and others. A line will be built from Balls Ferry to Anderson and Cottonwood.

SAN DIEGO, CAL.—The Home Telephone Company, which is to establish a local system, has filed articles of incorporation, the capital stock being $500,000. Among the incorporators are F. F. Graves and F. F. Boyce.

MORRIS, ILL.—The Stevens County Telephone Company has been reorganized with Mr. Berg as president.

TREMONT, ILL.—The Independent Telephone Exchange of Tremont has been incorporated by A. J. Davis, F. J. David and W. H. Ames. The capital stock is $20,000.

DUVALL, ILL.—The Okawa Township Telephone Company has been incorporated with a capital stock of $2500. The directors are G. L. McCullough, A. Roberts and others.

CHICAGO, ILL.—A rumor presages the organization of a telephone supply company to act in the interests of the Interstate Independent Telephone Association. Mr. Henry A. Barnhart, of Rochester, Ind., is quoted in a Chicago daily as saying such a company, with about $1,500,000 capital, is necessary to the life of the smaller independent telephone companies by reason of the absorption of supply houses.

WABASH, IND.—After wrangling for a year or more the city council has granted a franchise to the Central Union Telephone Company. The company's franchise expired over a year ago, and during this time the council and the company have been at sword's points while the company was doing business by sufferance. The officials of the Central Union say they propose making extensive improvements and will make a strong bid for a fair share of the business in Wabash and vicinity.

INDIANAPOLIS, IND.—The traffic committee of the Independent Telephone Association, which is composed of nearly all the long-distance independent telephone companies in the country, held a meeting in this city on April 2, and discussed plans for the betterment of long-distance service. Steps were taken toward the building of connecting links for the independent long-distance lines by agreeing to employ competent and expert telephone men to map out proper plans for perfecting the general scheme contemplated, and competent engineers to oversee the work. The members of this committee were appointed at a previous meeting and those attending the meeting were: F. S. Dickson, J. B. Hodge and B. W. Overley, of Cleveland, Ohio; C. H. Ledlie, R. M. Foster, St. Louis; M. R. Patton, Kansas City; C. L. Spain, Pittsburg, and S. P. Sheerin, Indianapolis.

SLOAN, IA.—The People's Rural Telephone Company is being formed here.

WEBSTER CITY, IA.—The Hamilton County Mutual Telephone Company has ordered a new switchboard, wire and other material, and will extend its system.

DES MOINES, IA.—The Hartley & Primghar Telephone Company, of O'Brien County, has been incorporated by W. N. Hulbert and others. The capital stock is $2000.

DES MOINES, IA.—The Elkhart Mutual Telephone Company has been incorporated with a capital stock of $10,000, the incorporators being O. F. Mathis, Albert Peterson, W. D. Cory, R. H. Ault and A. P. Besser.

ONOWA, IA.—The farmers of Fairview have decided to build an independent telephone line. The proposition of the Monona County Telephone Company to furnish service at $1.25 per month was not regarded by them favorably.

WHEATLAND, KAN.—The Wheatland Telephone Company has been organized to build a line from Wheatland to Conway.

PORTLAND, ME.—The Naples Telephone Company has been organized here to build lines in Naples, Bridgton, Casco and Raymond. The capital stock is $10,000.

DETROIT, MICH.—The Calhoun County Telephone Company has increased its capital stock from $150,000 to $250,000.

GRACEVILLE, MINN.—The Parnell Co-Operative Telephone Company has been granted a franchise in this place.

NEW ULM, MINN.—The Minnesota Central Telephone Company will build a line between this place and Sleepy Eye.

FARIBAULT, MINN.—Three telephone companies are seeking to do business in this city. The Northwestern (Bell) Company, which now controls the field, the Tri-State and a local company—the Rice County Telephone Company—are trying to secure franchises. Mr. A. R. Tracy, of Faribault, may give further information.

MERIDIAN, MISS.—The electrical committee has reported favorably on the movement to grant a franchise to an independent telephone company. The Cumberland Telephone Company also offered to grant any reasonable demands that would tend to lessen the friction which would be probable in case of two companies occupying the field.

NELSON, NEB.—The Nuckolls County Telephone Company will be organized here with a capital stock of $50,000.

MOCKSVILLE, N. C.—The Mocksville Telephone Company, of Mocksville, with a capital of $900 paid in and $10,000 authorized, has been chartered by L. G. Horn, of Mocksville, and others, to operate in five counties.

BINGHAMTON, N. Y.—The Treadwell Telephone Company has been incorporated to build a telephone line within the counties of Delaware and Otsego. The company now has about 100 miles of line and about 100 telephones in use.

SALEM, OHIO.—The Columbiana County Telephone Company is preparing to install new selective ringing telephones on its party lines in this district.

PAINESVILLE, OHIO.—The new telephone company organized at Perry, near here, has been organized as follows: President, W. W. Cook; secretary, F. E. Morrison; treasurer, E. M. Orcutt.

ALLIANCE, OHIO.—The Stark County Telephone Company has arranged a rate for interchange of service with the Bergholz Telephone Company and the Eastern Ohio Telephone Company. A rate will also be made with the Harrison County system.

ADAMSVILLE, OHIO.—The Adamsville Telephone Company has been organized with J. B. Rhodes, president; F. P. Winn, secretary, and S. M. Winn, manager. The company will install an exchange at Adamsville and will place contracts for material at once.

GIBSONBURG, OHIO.—The Seneca Telephone Company has been incorporated with a capital stock of $20,000 to build a line in Seneca and Sandusky counties. The incorporators are: N. B. Ervin, C. B. Synder, F. C. Hornung, F. W. Zorn and A. H. Miller.

LORAIN, OHIO.—The Ohio Telephone & Telegraph Company, which has been refused a franchise in Lorain, has made an arrangement with the Western Union Telegraph Company whereby it will use the latter's poles in Lorain and a small exchange will be fitted up.

CRESTLINE, OHIO.—The Crestline Telephone Company has elected J. Bapst, president; C. R. Callaghan, vice-president and general manager and F. A. Knapp, secretary. The company has 400 telephones in operation. It was decided to build new lines throughout the rural district in the vicinity of Crestline.

CINCINNATI, OHIO.—Mayor Mills has vetoed the ordinance granting a franchise to the Norwood Citizens Telephone Company. His reason for this action is that "It does not bind the company by bond or forfeiture to erect and operate a plant including an automatic exchange of reasonable capacity within a specified and reasonable time."

WEST MILLGROVE, OHIO.—A franchise has been granted to the West Millgrove Telephone Company, which will be incorporated at once with a capital stock of $2500. Construction material has already been ordered. The officers of the company are: President, Wilbur Rosendale; vice-president, J. P. DeWolfe; treasurer, C. D. Stearns; secretary, S. L. Ghaster.

CLEVELAND, OHIO.—The Federal Telephone Company has disposed of its interests in the Wood County Telephone Company, of Bowling Green, Ohio, to a company headed by H. A. Ashbrook, D. A. Yoder and J. S. Yoder, of Toledo. The company operates an exchange with 900 subscribers. It is the intention to reconstruct and extend the entire system and install a new board.

WOODSFIELD, OHIO.—The directors of the Woodsfield Telephone Company have chosen J. B. Rhoades as president; W. E. Mallory, vice-president; P. E. Fraley, secretary and treasurer, and F. C. Huth, general manager. The capital stock of the company was increased from $15,000 to $25,000. A number of extensions and improvements during the coming summer are contemplated.

CARNEY, OKLA.—The Carney Automatic Telephone Company has been organized here with a capital stock of $10,000. C. E. Wilcox, of Carney, is one of the incorporators.

QUAKERTOWN, PA.—The residents between Quakertown and Riegelsville along the line of the Quakertown & Eastern Railroad, are interested in the formation of a company to build a telephone line between the two towns. It is proposed to make a business arrangement with the Bell Company, which will make a charge of $3.60 per year per telephone.

TROY, S. C.—The Troy Telephone Company, of Greenwood County, S. C., has been commissioned with $800 capital. A. J. Davis and others are interested.

CHARLESTON, S. C.—The Edgemoor Telephone Company, of Chester County, S. C., has been chartered with $25,000 capital. H. B. Heath is president and J. D. Glass, secretary and treasurer.

ANDERSON, S. C.—The directors of the Anderson Telephone Company have decided to increase the capital from $10,000 to $30,000. This company owns several other lines in the county and has an agreement with the Bell Company as to long-distance service.

ABERDEEN, S. D.—The Dakota Central Telephone Company will extend its line from here to Mitchell.

LEWISBURG, TENN.—It is proposed to build a telephone line between Lewisburg and Yell. Mr. B. J. Coleman and J. K. Jobe are interested in the enterprise.

CORNERSVILLE, TENN.—A telephone company has been organized here to establish an exchange. A switchboard will be leased from the Cumberland Telephone Company, and the 25 subscribers will furnish the poles and wire and employ the operator.

ROCKINGHAM. VA.—The Rockingham Mutual Telephone Company has increased its capital stock $25,000.

SNOHOMISH, WASH.—The Skagit Farmers' Telephone Company has asked for a franchise in this place.

UTICA, WIS.—The Utica Telephone Company has been incorporated with a capital stock of $5000. The directors are G. Pickett, R. Mackie and others.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CAL.—An official of the California Gas & Electric Corporation says that while the water supply and electric power plants owned by the South Yuba Water Co. and the Central California Electric Co. have not yet been taken over, the option held will probably be exercised within a month. This deal and the taking over of the Standard Electric Co. were arranged for at the same and the financing of the one depended upon the other.

YREKA, CAL.—The Little Shasta Power Company, recently incorporated, will be a sub-company of the Siskiyou Electric Power Company. Contracts have been signed by the Siskiyou Electric Power Company to deliver at Montague all of the power required by the Little Shasta Company. The Little Shasta Company has purchased the Terwilliger power line and will sell electrical energy for light and power throughout the Little Shasta Valley. Mr. W. H. Roberts, M. T. Jones and J. F. Reisser are among those interested in the enterprise.

SAN FRANCISCO, CAL.—The Northern California Power Company, which has its principal office in San Francisco, and plants in Shasta County, has commenced paying monthly dividends, the first one of five cents per share being payable March 25, 1904. At the recent annual meeting of this company H. H. Noble was re-elected president; Edward Whaley, secretary, and Antoine Borel & Co., treasurer. The gross earnings of the company for the year 1903 were $150,924.56, while those for the preceding eleven months amounted to $85,582.35. The earnings for February, 1903, were $14,221.84; 1902, $9,224.44; increase, $4,997.40. The financial report showed a surplus net earnings to March 1, 1904, of $97,111.23. At present 3634 hp is being developed at the Volta power station, and an additional 4000 hp installation is almost ready for operation at the Kilarc station on Cow Creek. With a few weeks of dry weather this plant will be ready to transmit current over the new line which connects with the main transmission line at Delamar. An additional 3-phase line will extend down Pitt River to Kennet. Redding, Red Bluff, Tehama and a number of other towns in a territory extending over three counties are supplied with light and power from this system. The annual report mentions a rather high figure as an estimate of the amount of power which might be obtained by developing the company's water rights on Pitt River.

SAN FRANCISCO, CAL.—The details of the contracts recently awarded by the San Francisco Gas & Electric Company for the increase of plant at Station "A" include one General Electric 11,000-volt, three-phase rotating-field engine-type generator, a Union Iron Works vertical engine and five Babcock & Wilcox boilers. The generator will be direct connected to the triple expansion engine. Two of the engines from Station "B" will be moved to Station "A," formerly the Independent Electric Light & Power Company's plant. This will become the principal generating station for the city and will have a capacity of 15,000 kw or more. The present plans contemplate an increase of 10,500 kw there. The changes will enable the company to dispense with steam engines at the old stations. The contract for the new boilers was placed through Charles C. Moore & Co., who will also move six Heine boilers from another station and remodel the boiler plant. All of the boilers in the station will be equipped with B. & W. marine oil furnaces and the Charles C. Moore & Co. oil fuel system will be installed. Two special Goubert oil heaters will be used. The five new B. & W. boilers will have forged steel drums and superheaters. The auxiliaries will also be supplied through Chas. C. Moore Co. Steam-driven pumps will be used throughout instead of extending the electric motor system for condensing apparatus, etc. Two compound duplex Snow feed pumps each having a capacity to feed a 16,000-hp boiler plant will be installed.

WASHINGTON, D. C.—A bill has passed the Senate, and is now in the hands of the District of Columbia Committee in the House, providing for the regulation of electric wiring in the District of Columbia.

WASHINGTON, D. C.—Bids will be received April 19 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing 176 electrical equipments for ammunition hoists, etc., for the U. S. Navy. Address H. T. B. Harris, Paymaster-Gen., U. S. N.

JOLIET, ILL.—Harlow A. Griswold and Attorney G. A. Munroe, of Chicago, are interested in the construction of a power plant about 10 miles below Joliet. About $1,000,000 will be expended.

CICERO, IND.—John Plain, of Cicero, has secured a franchise for an electric light plant.

JASPER, IND.—The town of Jasper is negotiating with the electric light company for the purchase of its plant here. An appraisement has been made and a sale is quite probable. New machinery and other electrical apparatus will be added to the plant in case of sale.

VINCENNES, IND.—The Vincennes Light & Power Company, incorporated under the laws of Michigan, has been admitted to Indiana. The company will invest $200,000 in this city in the purchase and taking over the property of the Citizens' Gas Light Company and Vincennes Electric Light & Power Company and will hereafter operate the same. Edward M. Deane, D. W. Smith, H. T. Heald and E. M. Deane, all of Grand Rapids, are the stockholders.

OGDEN, IA.—The Northwestern Equipment Co., of Minneapolis, Minn., has secured the contract for constructing an electric light plant for $9000.

LOWELL, KAN.—The Spring River Power Co., of Lowell, has been incorporated, with a capital of $450,000, by Sam'l Brown, of Chicago; T. F. Garver, J. B. Larimer and others, of Topeka, to furnish electric power.

LOUISVILLE, KY.—An ordinance is before the city council requiring that all electric wires in the city be placed underground. A similar bill was presented a few weeks ago but it was withdrawn on account of some imperfections.

PRESQUE ISLE, ME.—The electric lighting and heating station owned by the Presque Isle Electric Light Company was destroyed by fire March 25.

PORTLAND, ME.—Electric wires on Congress street in this city are to be placed underground.

BALTIMORE, MD.—A bill has been reported to the Legislature at Annapolis requiring that all electrical contractors and workers shall be licensed, and providing for a Board of Managers.

ANNAPOLIS, MD.—A bill has been introduced in the Legislature providing that no telephone company shall engage in the electric lighting business in the City of Baltimore. The bill is said to be aimed at the Maryland Telephone Company, which recently applied for a franchise to conduct electric lighting in that city.

CAMBRIDGE, MASS.—The Massachusetts Board of Gas and Electric Light Commissioners has authorized the Cambridge Electric Light Company to issue $100,000 additional capital stock to pay for extensions to the plant.

BOSTON, MASS.—At the annual meeting of the Electric Lighting Engineers of New England, held at the Parker House on March 16, the following officers were elected for the ensuing year: President, J. W. Cowles, Boston; vice-president, F. S. Richardson, No. Adams; secretary and treasurer, C. R. Brown, Boston; directors, W. H. Coughlin, Worcester; F. C. Smith, Somerville; W. C. Woodward, Providence; W. E. Holmes, Newton; S. F. Smith, Salem; E. H. Mather, Portland.

GRAND RAPIDS, MICH.—The entire municipal lighting system in this city was put out of service a few days ago by the high water in the river extinguishing the fires in the boilers at the plant. The city was in darkness for the time being.

ST. LOUIS, MO.—A contract has been let for the erection of a power house between the observation wheel and the ice plant, just west of the power plant of Machinery Hall, at the World's Fair. This plant will supply the power for the wheel and the ice plant. The wheel will be illuminated by 6000 electric lamps. P. D. C. Ball, who is also installing the ice plant, is erecting the power house.

RENO, NEV.—The Reno Power, Light & Water Company is incorporated, with a capital of $1,000,000, by P. L. Flannigan and W. H. Patterson, both of Reno, and others.

DELHI, N. Y.—The question of issuing $20,000 bonds for a municipal lighting plant is under consideration here.

ROCHESTER, N. Y.—It is reported that the Clark syndicate, which controls the Rochester Railway Company, is negotiating for the purchase of the Rochester Gas & Electric Company. The railway company, it is stated, has not sufficient electric power. It now obtains 1000-hp. from the electric company. The latter concern owns extensive water rights, many of which have not been developed and which could be utilized for the generation of a large amount of power.

HILLBURN, N. Y.—A new plant is being built for the Rockland Electric Company at Hillburn, N. Y., to use the new high-powered Westinghouse gas engines with producer gas, using the Loomis-Pettibone system. This producer plant is located in a separate building, and supplies gas to the Ramapo Iron Works and the Ramapo Foundry Company for heating and metallurgical purposes, as well as power gas to the generating station. The electrical system will supply current to local industries, as well as light the Ramapo Valley some 14 miles in extent. The equipment aggregates 1200-hp power, employing 350 single crank engines of the double acting type, and a small vertical single acting engine for the exciter. Each main engine is direct connected to Westinghouse polyphase generators, arranged for parallel operation.

NEW YORK, N. Y.—The following are among the recent additions to the membership of the National Electric Light Association: Active: Colorado, Boulder, The Boulder Electric Light and Power Company; Michigan, Cheboygan, Cheboygan Electric Light and Power Company; Minnesota, Montevideo, Montevideo Electric Light and Power Company; Mississippi, Indianola, Indianola Light, Ice and Coal Company; Missouri, St. Joseph, St. Joseph Railway, Light, Heat and Power Company; Ohio, Bellevue, The Bellevue Light and Power Company; Ohio, Massillon, Massillon Light, Heat and Power Company; South Carolina, Darlington, Darlington Light and Water Company; Texas, Beaumont, Beaumont Ice, Light and Refrigerator Company. Associate: New York City, J. J. Kennedy, Consulting Engineer; New York City, The Cassier Magazine Company; Philadelphia, Pa., James H. Dawes, Supt. of Construction Nat'l Gas and Construction Company.

JONESBORO, N. C.—A. F. Spencer, of Sanford, N. C., has been granted a franchise to supply light, heat and power in this place. He has also secured the contract to light the streets with arc and incandescent lights for five years.

DAYTON, OHIO.—Mayor Snyder has vetoed the ordinance granting a franchise to the Dayton Electric Light Company. The reasons for the Mayor's actions are, it is stated, that the company has not kept its contract with the city as to prices for commercial lighting and power; that the ordinance does not impose underground wire conditions, besides other reasons.

EL PASO, TEX.—The Southern Pacific Company will install an electric power plant here for the operation of the machinery of its railroad shops.

BRYAN, TEX.—The city council of Bryan has granted a franchise to H. B. Dorsey, of this place, for the erection and operation of an electric light and power plant here.

SOUR LAKE, TEX.—Two applications for franchises to establish an electric light plant and a water works system at Sour Lake are pending before the city council. One application is by Messrs. Sloan, Maxwell and McVeigh, of Sour Lake, and the other by Mrs. C. W. Allen, of Houston.

SALT LAKE CITY, UTAH.—Articles of incorporation of the Standard Power Company, with a capital stock of $1,000,000, have been filed with the Secretary of State. The purpose of the company is to establish a power plant at a cost estimated at $500,000 on the Sevier River in the southern portion of the State. It will have a capacity of about 5000 horse-power, and work on the project will be commenced early during the present season.

WAUWATOSA, WIS.—The action of the city administration last fall in giving away electric street railway and lighting franchises, in opposition to a petition of voters asking for a referendum vote, was the cause of an earnestly fought contest at the recent municipal election resulting in victory for the independent citizens. A proposition for a twenty-year franchise for city lighting by a Milwaukee company was defeated by a large majority.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham Railway, Light and Power Company has voted to issue $10,000,000 bonds for refunding and for improving the system.

WILMINGTON, DEL.—The Wilmington New Castle & Southern Railway Company has been organized with the following officers: Henry L. Evans, president; Willard Saulsbury, vice-president; Chauncey P. Holcomb, secretary; Francis R. Morrison, treasurer; Henry L. Evans, Harry A. Richadson, Peter J. Ford, Willard Saulsbury, T. Bayard Heisel, Harry J. Stoeckle and Francis Kelley, directors. The capital stock of the company is $300,000. The new company is the result of a merger of the Wilmington & New Castle and the New Castle & Delaware City companies. The officers of the new company were authorized to issue $650,000 bonds, of which $300,000 are to be used in taking up bonds to the same value of the constituent companies, and the proceeds of the remainder are to be utilized for improvements and extensions.

ATLANTA, GA.—A charter for the Piedmont Electric Railway Company to extend from Atlanta to Roswell, Alpharetta and Cumming, Ga., has been granted to E. S. Brazelton, of Birmingham, Ala.; Charles Kingsbery, E. C. Atkins, T. J. Hightower, C. W. Hunnicutt, John T. Stocks, H. L. Hunter, B. F. Curtis, Charles R. Maddox, R. E. Bondurant, J. A. Tiler and John Burnett, of Atlanta.

CHICAGO, ILL.—The stockholders of the Lake Street Elevated Railroad have voted to change the name to the Chicago & Oak Park Elevated Railroad Company.

JOLIET, ILL.—The Joliet, Newark & Southwestern Railroad Company, of Newark, has been incorporated, with a capital stock of $10,000. The incorporators are: H. K. Thunemann, O. L. Miller, A. M. Sweetland and others.

CHICAGO, ILL.—The South Side Elevated Railroad Company stockholders voted unanimously to increase the capital stock of that company by $7,226,700 to a total issue of $17,550,500, at a special meeting on April 7. The proceeds of this new issue will be used to defray the cost of the proposed extensions to Englewood and to the Stock Yards, and for the construction of a third track for express service between 12th Street and 43d Street.

BLOOMINGTON, ILL.—The Springfield, Lincoln, Bloomington, Pekin & Peoria Electric Railway, incorporated recently, with a capital stock of $50,000, is to be organized here on April 12. The plan of the company is to build an electric railway from Bloomington to Lincoln and thence to Springfield, and from Peoria to Lincoln, with a cross line from Morton to Pekin. F. H. Funk and F. W. Aldrich, of Bloomington, are among those interested.

CRAWFORDSVILLE, IND.—It is stated that the Consolidated Traction Company will erect a power house at once. Edward Hawkins, Indianapolis, is president.

NEW ALBANY, IND.—The directors of the Highland (Electric) Railroad have ordered that this road, which ceased operations three months ago, be offered for sale at auction.

BEDFORD, IND.—The Bedford Street & Interurban Railway Company has organized as follows: V. V. Williams, president; W. N. Mathews, vice-president; E. B. Thornton, treasurer; W. R. Martin, secretary.

EVANSVILLE, IND.—A. L. Rich, of Cincinnati, and H. W. Richardson and J. E. Bohanon, of Louisville, who recently purchased the Henderson (Ky.) City Railway system for $250,000, announce that they will at once extend the road a distance of 12 miles to Evansville, and establish an interurban system between the two cities. The Evansville & Henderson Traction Company, capitalized at $10,000, has filed articles of incorporation. The directors are: H. E. Randall, C. C. Tennis, J. W. Prietiard and C. H. Baltin.

TERRE HAUTE, IND.—Contracts will soon be let for the construction of the new power house of the Terre Haute Electric Company. Contracts for the machinery for the plant were let early in the year. The General Electric Company will furnish all of the electrical machinery. The boilers will be furnished by the Aultman & Taylor Company.

INDIANAPOLIS, IND.—The Union City, Winchester & Muncie Traction Company has filed articles of incorporation. The company is capitalized at $10,000, but reserves the privilege to increase the capital to $2,000,000. The company proposes to build a line from Union City to Muncie. Dr. J. E. Lowes, J. E. Feight, Theodore Shockney and W. B. Gebhart are the incorporators.

LEBANON, IND.—At the annual meeting of the stockholders of the Indianapolis & Northwestern Traction Company the following officers were elected: George Townsend, president; Philip L. Saltonstall, vice-president; Chauncey Eldridge, treasurer; Winthrop Smith, secretary; George Townsend, W. S. Reed, S. R. Anthony, Thos. Pettigrew, Philip Saltonstall, Chauncey Eldridge and Winthrop Smith, directors.

IOWA CITY, IA.—The city council has voted a franchise to the Iowa City, Davenport & Muscatine Electric Railroad. A special election will be held at an early date for the purpose of ratifying this action of the council.

COLUMBIA, KY.—W. K. Azbill, of Columbia, says the plan to build an electric railway between Columbia and Lebanon, a distance of 46 miles, is in the primary stages.

SPRINGFIELD, MASS.—The Springfield & Eastern Railway Company, operating in and about Palmer, has decided to apply for a grant of location from Ludlow into Springfield.

NEWBURYPORT, MASS.—The Citizens' Electric Street Railway Company lost about $60,000 March 28, by the burning of its car houses on Merrimac Street and some twenty-eight cars and plows. Seven cars were in use on the street, and these are all that were saved.

FITCHBURG, MASS.—The directors of the North Leominster, Shirley & Ayer Street Railway have voted to begin at once the construction of a line from North Leominster to Ayer. W. W. Sargent, superintendent of the Fitchburg & Leominster Street Railway, is to have general charge of the new line, which makes connection at North Leominster with the Fitchburg & Leominster. It is the intention to build on to Lowell eventually.

NEGAUNEE, MICH.—Among the improvements contemplated by the Negaunee & Ishpeming Street Railway & Electric Co. is the enlargement of the electric light plant, for which plans are now being prepared. An order will soon be placed for the new machinery. The capacity will be increased from 5000 to 10,000 incandescent lights. H. F. Pearce, Negaunee, is manager.

ST. LOUIS, MO.—Mayor H. L. Ponder, of Walnut Ridge, Ark., and S. C. Dowell, president of the Lawrence County bank of that city, were in St. Louis recently to complete arrangements for the organization of the Hoxie and Walnut Ridge Electric Light, Power and Transit Company, a venture in which some prominent St. Louisans are interested. The company is capitalized at $65,000, and its primary purpose is the installation of an electric railway between Hoxie and Walnut Ridge. These towns are connected now by a mule car line.

LINCOLN, NEB.—The property of the Lincoln Traction Company will be resold, Judge Holmes having decided that the company's bid of $1,025,000 for its own property did not comply with the terms.

RENO, NEV.—The franchise and property of the Reno Traction Company has changed hands by purchase, and S. C. Griffith, president of the company, announced that work on the prospective road will be commenced at once.

ROCHESTER, N. Y.—The Rochester, Scottsville & Caledonia Railway Company has been organized.

WELLSVILLE, N. Y.—Interest has again been revived in the proposed electric railway from Wellsville to Bolivar. Oak Duke, of Wellsville, is interested.

AMITYVILLE, N. Y.—The Huntington & Amityville Traction Company has accepted the franchise granted it here, and posted a bond of $7500 to insure compliance with the terms of the grant.

ADDISON, N. Y.—Attorney Seibert, of Coudersport, is interested in the proposed electric railway from Addison to Olean, connecting at the latter place with the proposed line to Bolivar. The distance from Addison to Olean by this route is about 72 miles.

CINCINNATI, OHIO.—The statement is made here that the Westinghouse Company is negotiating for the equipment of the Cincinnati, Dayton & Toledo Traction Company with single-phase motors.

CLEVELAND, OHIO.—On April 2 more than 100 of the motormen and conductors of the Cleveland & Southwestern Traction Company went on strike because of the refusal of the company to remove General Manager Nicholls, who is charged by the men with making rules unfair to them.

TOLEDO, OHIO.—The Toledo Railways & Light Company is building an addition to the boiler house at its main power station, and has placed a contract with the Ricard Boiler Company, of Toledo, for four 650 hp water-tube boilers, to be equipped with stokers.

BOWLING GREEN, OHIO.—The Lake Erie, Bowling Green and Napoleon Railway Company has filed a mortgage for $1,000,000 to the Union Trust Company, of Detroit. The money will be used in extending the road eastward to Port Clinton and westward to Napoleon. Work on the extensions is to start at once.

PITTSBURG, PA.—The McKeesport & Clairton Connecting Railway Company has accepted the ordinance granting the company a right of way in McKeesport.

HARRISBURG, PA.—The State Department has issued a charter to the Allen Street Railway Company, capital $30,000, to build a 5-mile line between Nazareth and Bath, Pa. The directors are: Thomas D. Danner, of Easton, president; Peter Raub, J. R. Ballentine, H. G. Seip, Edward McCaffrey, C. F. Seip, all of Easton.

HARRISBURG, PA.—A charter has been issued by the State Department to the Grove City Street Railway Company, capital $18,000, to build a 3-mile line in Grove City. The officers are: Edward Austin, president; R. N. Washabaugh, Arthur H. Springer, Samuel G. Bailey, J. H. Mehring, A. B. Stone, Vernon Hazard, directors.

BRISTOL, VA.—Plans are being discussed for building an electric railway from Cleveland, Va., to Lebanon, and thence through Washington County to Bristol.

RICHMOND, VA.—The street railway company here has announced that after April 15 it will enforce the law which permits conductors to separate white and negro passengers. Any persons failing or refusing to observe the orders of the conductor will be liable to a fine of $25, and may also be ejected from the car for such refusal.

NORFOLK, VA.—The Norfolk, Portsmouth & Newport News Company in which has been merged the Norfolk Railway & Light Company, the Berkley Street Railway Company and other like concerns, it is stated, is about to be dissolved. It is reported that the dissolution is due to the fact that after a trial the combined railways did not find the arrangement profitable and all concerned felt that by the individual operation of the roads larger dividends could be paid to the stockholders.

WELLSBURG, W. VA.—H. G. Lazear, of Wellsburg, has been granted a franchise for the construction of an electric railway from Wellsburg to Bethany.

WATERTOWN, WIS.—The City Council has passed the franchise giving the Oconomowoc & Watertown Heat, Light & Power Company permission to build an interurban electric railway through the city.

PORT ARTHUR, ONT.—The Electric Railway & Light Commissioners have recommended the installation of a storage battery plant in the power house.

SARNIA, ONT.—The St. Clair Tunnel Company has had engineers on the ground making estimates on the cost of installing a system of electric power for operating the trains through the tunnel.

NEW INDUSTRIAL COMPANIES.

THE AUTOMATIC SCENIC PHONOGRAPH COMPANY has been incorporated in New York with a capital stock of $5000. The directors are: C. C. Reinhardt, Christopher Peel and C. T. Willard.

THE CENTURY ELECTRIC CORPORATION, of San Francisco, Cal., has been formed by F. M. Greenwood, C. M. Wood, E. F. Weihe, L. D. Hitzeroth and H. S. Tittle, with a capital stock of $250,000.

THE TALMONT ELECTRIC ENGINEERING COMPANY has been incorporated in New York with a capital stock of $5000. The directors are: Adolph Talmont, G. D. Roedelsperger and M. J. Hornthal.

THE McCLEARY ELECTRIC COMPANY has been incorporated at Detroit, Mich., with a capital stock of $10,000, of which $6500 has been paid by a transfer of the McCleary & Colquitt Company's stock and fixtures.

THE ELECTRIC SUPPLY AND MAINTENANCE COMPANY, of Troy, N. Y., has elected officers as follows: President, A. V. Phillips; vice-president, A. S. Crable; secretary, Henry Schneider; treasurer, H. G. Hammett.

THE BISON MOTOR COMPANY, of Buffalo, N. Y., has been incorporated to manufacture motors, engines, etc., the capital stock being $25,000. The incorporators are: F. I. Alliger, Tonawanda; F. Wende, Wm. A. Lutz, Buffalo.

THE RANDALL MOTOR CAR COMPANY, of Ft. Wayne, Ind., has incorporated capitalized at $10,000. The company's manufacturing plant and principal office will be in Ft. Wayne. F. P. Randall, A. L. Randall and Louis Olmhaus are directors.

THE HEAT, LIGHT AND POWER IMPROVEMENT COMPANY OF AMERICA has been incorporated in New York City with a capital stock of $600,000. The incorporators are James P. Bowery, Andrew Ritchie and Charles Eldridge, of New York City.

THE SOLOMON RIVER DITCH COMPANY has been organized at Portland, Me., for the purpose of conducting a general electrical power, light and heat business. The capital stock is $1,000,000, of which nothing has been paid in. George F. Gould, of Portland, has been elected president.

LEGAL.

INDEPENDENT TELEPHONES IN CINCINNATI.—Judge Nipper in the Probate Court at Cincinnati, has decided that independent telephone companies have the right to use the streets of Cincinnati. This right, he stated, was granted by the statutes of Ohio, and all the court was required to do was to decide the manner in which the streets shall be so occupied. The companies concerned are the Cincinnati Telephone Company, the Queen City Telephone Company, the Fitzsimmons Company and the Interstate Company.

TELEPHONE POLES IN HIGHWAY.—The New York Supreme Court, Appellate Division, Third Department in the case of Gray et al, versus York State Telephone Company, has held that (1) The erection of telephone poles in a rural public highway is an added burden to the owners of the adjoining land, who own the fee in the highway, the right to impose which must be obtained either by consent of the owners or by condemnation proceedings. (2) The owners of the fee of a highway may prevent the erection of telephone lines thereon for permanent use by injunction.

ST. LOUIS ELECTRIC LIGHT CONSOLIDATION.—Morgan Jones, of Denver, Col., has brought suit in the United States Circuit Court to set aside the consolidation of the Missouri Electric Light & Power Company, the Union Electric Light & Power Company and the Citizens' Electric Light & Power Company, of St. Louis. These companies are constituents of the North American Company, of New York. Mr. Jones alleges that the merger was effected by fraud and asks for an injunction to restrain the officers of the consolidated companies from a further use of funds and for the appointment of a receiver to take charge of the Missouri-Edison Company's property.

HOUSE MOVING AND TELEPHONE LINES.—The Supreme Court of North Dakota has decided an interesting and novel case, on appeal, as follows: 1. A person licensed to move houses in the city of Grand Forks is legally liable for damages done by him while moving a house, such damage being done to the wires and property of a telephone company, duly authorized by ordinance to establish a telephone system in said city and maintained therein. 2. By the passage of such ordinance, which gave the city benefits, and its acceptance by the company, and its expenditures thereunder, a contractual relation was created between the company and the city, which became a vested right that could not be impaired by subsequent action of the city directly or indirectly annulling it for purposes not public, and for purposes of a personal or private nature. 3. The use of a street for moving houses is an extraordinary use thereof. Such use may be permitted, but not so as to destroy the use of the street for travel or necessary public purposes, and cannot be legally done in destruction or impairment of vested rights. The building moved was 7 feet higher than the highest telephone circuit in question.

FORFEITURE OF TELEPHONE GUARANTEE.—In the Supreme Court of Michigan, in the suit of the City of Detroit vs. the People's Telephone Co., of Detroit, the decision of the lower court forfeiting $1529 with interest was affirmed last March on the ground that where a telephone company pursuant to its franchise had deposited with a city a sum of money as guarantee that its system should be in operation within a certain time, to be forfeited in case of failure, the entire sum was forfeiture by failure and not merely such portion as would compensate the city for the damages suffered. Upon the trial the evidence showed that the company had commenced the construction of the plant within the required time, and had procured 3500 bona fide subscribers, as required. But the evidence of the defendant also showed that it had not operated the system put in by it, with the exception of some 30 telephones placed in an interior exchange at the Parke, Davis & Co. plant, and also that they were not in position at the time of the trial to supply any more patrons with telephones. The contention of the defendant was that for any breach of the conditions imposed by section 10 the city was only entitled to such compensation and damages as it could be shown that it suffered by reason of the default of the telephone company, and that, as no such damages were shown, the defendant was entitled to offset the $5000 and interest, and recover the balance above plaintiff's claim. The circuit judge held otherwise, and directed a verdict for the plaintiff for the full amount claimed.

OBITUARY.

MARTIN D. WOOD, who was for 35 years local manager of the Western Union Telegraph Company at Kansas City, Mo., died there April 6, aged 60 years. He was a veteran of the civil war.

MR. THEODORE E. THEBERATH, who was formerly engineer for the San Francisco District agency of the Stanley Electric Mfg. Company, died at his home in San Francisco, March 29, after a brief illness. He was a native of New Jersey and 40 years of age. Mr. Theberath of late years was in the employ of the California Gas & Electric Corporation, his last work being as superintendent of the construction of the DeSabla water power electric plant. The funeral took place on April 1. His wife survives him.

MR. R. WELLS.—A special telegram from Glens Falls, N. Y., of April 9, says: Raymond Wells, a civil engineer in the employ of the Hudson River Water Power Company, received a shock from an electric wire carrying 30,000 volts at the Spier Falls power house of the company late yesterday, and was so badly injured that he died from the effects at midnight. He was on the roof of the power house making some measurements, and accidentally touched with a steel rod he was carrying a wire heavily charged with electricity.

MR. J. L. WEEKS, general manager of the American Steam Gauge and Valve Co., Boston, Mass., died in that city on April 2 after an operation for appendicitis the day previous. Mr. Weeks was well known in the electrical and steam engineering fields throughout the country, and it was principally due to his energetic and persistent efforts that the business of the company he managed was brought to the prominent place it occupies amongst steam specialty manufacturers. The remains were taken to Chicago for burial. Mr. Weeks was only 37 years of age.

MR. CHARLES WATSON.—We regret to note the death of Mr. Charles Watson, a gas pioneer, more lately identified also with electric lighting, etc. He died at Camden, N. J., March 30, aged 73. He was born at Portland, Me. He was one of the organizers of the Camden Gas Light Company in 1854, and served as its secretary and treasurer for over 25 years. He resigned from its service when the company was absorbed by the South Jersey Gas, Electric and Traction Company. At the time of his death he was a director in the Public Service Corporation of New Jersey, and was actively connected with many other important financial and commercial enterprises of South New Jersey. Among the pallbearers were John J. Burleigh and Judge Armstrong, of the National Electric Light Association.

MR. J. W. HINKLEY.—Mr. James W. Hinkley, president of the United States Casualty Company of New York, and for a number of years prominent in Democratic State politics, died suddenly on April 11 at Poughkeepsie, N. Y. Mr. Hinkley had not been in good health for a year. He was born in 1850 at Port Jackson, Clinton County, N. Y., and was educated at the Smith and Converse Academy and at the West Point Military Academy. He went to Poughkeepsie and became owner of *The News Press*. Later he purchased and assumed editorial control of *The New York Daily Graphic*, which brought him in contact with prominent men of each of the political parties, but particularly with the leaders of the Democratic party in this State. Mr. Hinkley was very successful in business and quite active in electrical affairs. He was president of the Poughkeepsie City and Wappingers Falls Electrical Railway Company, president of the Walker Electric Company, of Cleveland, Ohio; a director of the Poughkeepsie Trust Company, and of several New York banks. Mr. Hinkley is survived by his wife and eleven children, one of whom is Capt. J. W. Hinkley, Jr., stationed at Fort Washington, Md.

PERSONAL.

MR. DWIGHT C. CLOUGH has been appointed city electrician of Long Beach, Cal.

MR. C. C. CRAFTS, of the New York export department of the Westinghouse Electric interests, has returned from a four weeks' trip to Mexico.

MR. F. D. PHILLIPS, formerly with the Electric Appliance Company, is now identified with the Crescent Company, of Chicago, of which he has recently been elected vice-president.

MR. F. A. PICKERNELL, chief engineer of the American Telephone & Telegraph Company, has been in the West on a tour of inspection. He was in Salt Lake City at last reports.

MR. W. MURRAY CRANE, ex-Governor of Massachusetts, and largely interested in the Bell telephone system, and Clarence H. Mackay, president of the Commercial Cable Company, have been elected directors of the Manhattan Trust Company.

MR. W. J. HAMMER.—The handbook on radium by Mr. W. J. Hammer is one of the "Best Fifty" books voted as desirable this year for a village library, in connection with the list submitted to librarians of New York by the New York State Library.

MR. CHARLES MAUTNER, well known in electrical circles in and around New York, has assumed the general management of the newly organized Switchboard Company, of New York, which will manufacture a full line of switches, switchboards and panel boards.

CLARK & MACMULLEN, INC., electrical and consulting electrical engineers, have moved their Pittsburg office to the Farmers' Bank Building, that city.

MR. W. S. ACCLES, European representative of the Miles-Bement-Pond Company, is now on a short visit to this side.

MR. EDMUND ALO, the Swiss hydraulic engineer expert who was recently commissioned by the New Zealand government to ascertain the possibilities of local rivers for generating electric current, is to take up his abode permanently in the Antipodes, as consulting engineer in electricity and hydraulics.

MR. W. F. WARDEN, president and general manager of the Burt Manufacturing Company, sailed for Europe in the Celtic April 15, where he will visit agents of his company in England, France, Germany, Belgium, Norway, Sweden, Denmark, Russia, and, if time permits, in Switzerland, Greece and Spain.

MANAGER WICKHAM, of the Hongkong (China) Electric Company, is at present in the United States. He will visit some of the principal power stations and electric manufacturing plants in the East and Middle West. He is now in Pittsburg, but will be in New York early next week at the Hoffman House.

MR. LE ROY W. STANTON, the well-known electrical engineer, of Cleveland, Ohio, will read a paper on "Modern Telephone Engineering" before the International Electrical Congress, which will be held at St. Louis next September. He has just opened a branch office in Chicago, in the Monadnock Building, in charge of Mr. Byron B. Carter.

MR. ROBERT L. WARNER has been relieved of the detail duties of the management in connection with the Boston office of the Westinghouse Electric and Mfg. Co., and appointed New England manager. He will have general charge for that section, and Mr. D. E. Manson will assist him, with the position of manager of the Boston office.

MR. RALPH G. ARNOLD, treasurer of the Arnold Electric Power Station Company, was married recently at Brooklyn, N. Y., to Miss Hazel McLain, The wedding was at the house of the bride, those present being members of the immediate families. After a short trip in the East, Mr. Arnold and his bride will take up their residence in Chicago.

PROF. A. G. BELL has decided to give a public exhibition of his famous tetrahedron kite, until now seen by no one but the men who helped him to construct it and to fly it at Cape Breton Island over a year ago. The exhibition is to be given before the National Geographical Society at an open-air meeting and exposition, to be held on Saturday, April 30, at Washington.

MR. JOHN D. HIBBARD and Mr. Paul Platchford have been re-elected as president and secretary respectively of the Chicago Metal Trades Association. This association of employers has done much to improve a very troublesome labor field, and these two men have won the respect and esteem of the labor union officers while bringing about more harmonious relations with their employees.

MR. CHARLES F. FOSTER has been appointed chief operating engineer of the power plant of the Louisiana Purchase Exposition. Mr. Foster was the chief mechanical engineer at the World's Columbian Exposition in 1893. He is vice-president of the National Supply Company and a member of the American Society of Mechanical Engineers, the St. Louis Engineers' Club and the Western Society of Engineers.

MR. E. R. CARICHOFF, formerly chief engineer of the Otis Elevator Company, and now with the International Steam Pump Company, is installing for that company a very complete lighting and power distribution plant at the Harrison Works. The generating plant is of 1000-kw. capacity, with space reserved for future enlargement. All tools will be driven by electric power, many having individual motors.

MR. J. D. ROCKEFELLER has made a contract with the Cleveland and Southwestern Traction Company for delivering by freight trolley to his summer home at Forest Hill, near Cleveland, a large amount of fine washed gravel for making roadways and walks in his private park. He bought a gravel bank at Wellington, 45 miles from Cleveland, and the material will be screened and washed and delivered to Forest Hill in bags at night.

MISS SARAH FARMER, daughter of the late Prof. Moses G. Farmer, has just sustained a severe and irreparable loss in the destruction by fire of the old homestead at Greenacre, on the Piscatauqua River, near Eliot, Me. The house was full of relics of the family and of her father's electrical inventions and studies, and these of course can never be replaced. The American Institute of Electrical Engineers had a meeting there in the summer of 1897, and enjoyed generous hospitality at Miss Farmer's hands.

THE GENERAL ELECTRIC ENGINEERING SOCIETY, of Lynn, Mass., recently held its annual election of officers with the following result: President, C. M. Green; vice-president, A. E. Hayes; secretary, G. E. Sanford; treasurer, F. D. Bartlett, executive committee, E. E. Boyer; technical committee, R. Fleming, chairman, G. H. Pickney and J. M. Davis; membership committee, H. J. Arnold, chairman, C. A. Stanley, J. Walsh, R. W. Douglas and E. M. E. Humphries. On April 22 Mr. D. B. Rushmore will speak on "Alternator Design."

MR. G. MARCONI.—A dispatch from Rome, Italy, says: People who think of Marconi only as the inventor of the wireless telegraph do not know the scope of his talents. He has a fine tenor voice and has been chosen by the Abbe Perosi, the leader of the Sistine chapel-masters, to sing one of the principal parts in his new oratorio, "The Universal Judgment." The Pope recently had an interview with this future interpreter of his favorite contemporary musical authority. Marconi offered even to sing for him, but his Holiness said he did not wish to take advantage of the latter's willingness to oblige. He asked Marconi in what church he would sing, and when the latter replied that he would not sing in a church, but at the Costanza, the Pope sighed a little, as if he found the bounds of the Vatican very narrow.

SIR OLIVER LODGE has ideas in religion as well as in electricity. A controversy over the Sacred Scriptures has arisen recently in England, in which he takes a hand, advocating a reinterpretation of Christian doctrine. He regards the "doctrine of atonement in its concrete form as a survival from barbarous times," repudiating the belief in "an angry God, appeased by the violent death of Christ," and maintaining that human nature now is "rising to the conviction that we are part of nature and so part of God. In this sense the union of divinity is what science some day will tell us is the inner meaning of the redemption of man."

MR. ARTHUR WILLIAMS, general inspector of the New York Edison Company, receives an extraordinary tribute at the hands of the *New York Commercial*, in its rather vigorous discussion of rates and charges. It says that it is almost worth being overcharged to gain the privilege and interview with this "highly gifted conversationalist" and adds: "What salary the company pays Mr. Williams is unknown; but whatever it be, it is not one-half of what he earns. To have such a perennial fount of the milk of human kindness, qualified with just a dash of blarney, welling forth in the complaint department of an electric light company, calming the perturbed spirit of its exasperated, not to say murderously-inclined patrons with honeyed gush is worth a deal of money to the corporation." It might be noted that Mr. Williams's topic was the Thomson wattmeter, whose merits the daily newspaper man was not quite ready to admit.

Trade Notes.

CHANGE OF ADDRESS.—The DeForest Wireless Telegraph Company has moved its headquarters from 100 Broadway to 42 Broadway, New York.

THE BUFFALO BOX FACTORY, Buffalo, N. Y., which was recently destroyed by fire, will be rebuilt and equipped with an electric power plant.

CARLETON-CHASE ELECTRIC CO., New York, has moved to 37 Warren Street, where all orders will be promptly filled and business carried on as usual in spite of the recent fire in its old quarters.

LARGE METER.—The Duncan Meter Company, of Lafayette, Ind., is making a meter for the new Chicago postoffice, which, it is said, will be the largest meter ever built. It will register 42,000 16-cp incandescent lights.

THE CRESCENT COMPANY, Chicago, has found it necessary to equip its factory with electric drive in order to take care of its constantly increasing orders for the Crescent soldering sticks and Crescent soldering paste.

THE MAXFIELD-FRANCKE CO., representing the Francke four-ported engine, has removed its offices to the Electrical Exchange Building, 136 Liberty street, New York City, where it will be glad to receive visitors and inquiries.

THE ELECTRIC APPLIANCE COMPANY, Chicago, reports that its sales on Packard lamps during the winter just past have far exceeded all previous records. This, the company states, is no phenomenon, but merely a result of the maintained efficiency of the high-class Packard product.

NUERNBERG CARBONS.—We are advised that after careful and exhaustive tests, the Louisiana Purchase Exposition Company of St. Louis has given a contract to Mr. Hugo Reisinger, of Bowling Green Building, New York, for his "Electra Highest Grade Nuernberg" carbons for its entire requirements of carbons. This means that the World's Fair grounds and all the buildings, so far as the arc lighting is concerned, will be illuminated exclusively by these carbons.

REFLECTORS.—The National X-Ray Reflector Co., Chicago, manufactures a complete line of X-ray sterling silver plated glass reflectors for electric and gas lighting. In a neat catalogue just issued these goods are well illustrated, the variety of designs being the most conspicuous feature. These reflectors are corrugated spirally or radially, or both, which arrangement insures powerful reflection of the light. Mr. C. J. Purdy, 26 Cortlandt street, is the manager of the company's New York salesrooms.

THE V. R. LANSINGH COMPANY, of Chicago, is equipping the entire large booth of the Singer Manufacturing Company in the Manufacturer's Building at the St. Louis Exposition with Holophane globes. This company is also equipping the Singer Manufacturing Company's Sixth Street store in St. Louis with Holophane globes throughout. The jury room in the Electricity Building and the offices of Prof. Goldsborough, chief of the Department of Electricity, are to be equipped with Holophane globes and pagoda reflectors.

THE YALE & TOWNE MFG. CO. has made preparations to install a very extensive exhibit at the Louisiana Purchase Exposition, showing chain blocks, overhead carrier systems and labor-saving appliances in actual use, and demonstrating the vast economies represented by up-to-date hoisting and transferring methods as compared to old methods. The exhibit will contain some entirely new features in the way of improved hoisting equipment, and will be of especial benefit to engineers interested in economical handling and transferring of material.

STANLEY SYSTEM SYNOPSIS.—We have received from Mr. Ray D. Lillibridge, 170 Broadway, a copy of the "Synopsis of the S. K. C. System," which he has just issued for the Stanley Electric Manufacturing Company, of Pittsfield, Mass. This compendium, of about 48 pages, covers virtually all the products of this progressive concern, and contains the pith of a great many bulletins already issued, and gives all the facts and data in a more condensed form, but still illustrating profusely. In case the larger bulletins are desired, a numbered list of them is given.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, is receiving a large call for its new "never failing" self-restoring drop, not only for complete switchboards for new exchanges and re-equipping plants, but for extending boards of other makes. Its combination jack and self-restoring drop is arranged in strips of five and can readily be mounted on any other make of switchboard, and has the jack ferrule constructed to fit any size plug. The spring jack being designed so as not to depend on the ferrule for a connection, makes a positive and reliable plug contact at all times.

"MACHINE TOOLS" is the title of a very massive and handsome catalogue in quarto form just issued by the Niles-Bement Pond Company, of New York. It contains 713 pages, nearly every one of which is illustrated with a large well-made half-tone cut. The engravings are printed in black and the type matter is in brown ink. There are hundreds of cuts, of machine tools and parts, as well as several fine pictures of factories, medals, diplomas, etc. One section deals with electric traveling cranes which are fully illustrated and de-

scribed. The cover is a brilliant red cloth and the end papers carry the repeated initials of the concern, as a device.

U. T. HUNGERFORD BRASS & COPPER CO.—The Waterbury Brass Co., No. 122 Centre Street, New York, has closed its New York store, and the entire stock has been purchased by U. T. Hungerford Brass & Copper Co., 497-505 Pearl Street, New York. This addition will, it is said, give the last-named company a larger and more varied stock (about two million pounds) of brass, copper, etc., in various forms, than was ever before under one roof. The increasing business of the Hungerford Company has rendered necessary the erection of another building adjoining its present commodious quarters, which will be ready for occupancy about April 15.

"IMPERIAL SOLDERENE" is a new and convenient preparation for soldering purposes, particularly in electrical work. It is a pure, high-grade solder, ground and mixed with special, quick-acting fluxes, and compressed into hexagonal stick form. It requires but a very low temperature in actual use, but when set a high temperature makes little or no effect. The heat applied first melts the "carrier," which requires about 180 degrees, and the carrier then becomes a conductor of heat and is volatilized as the comminuted solder fuses and adheres. Samples of work shown us are very satisfactory and complete. It is made up and put on the market at low price by W. Green & Co., Maiden Lane, New York City.

THE EUREKA ELECTRIC COMPANY, of Chicago and Genoa, Ill., is now running its factory overtime and reports a most successful spring outlook for business. Its factory has been extremely busy for the past 10 weeks, and orders are coming in very heavily on its new switchboard apparatus, which is securing a very high endorsement of all who have seen the same. The company will be pleased to send its latest 1904 bulletin and printed matter describing its well-known line of apparatus to any company desiring the same. The company has also issued a novel little folder, being a miniature facsimile of its model 99 telephone set in natural colors, showing its front appearance and the interior. It is circulating some 250,000 of these among the trade.

PLATINUM and its allied metals, which depend almost entirely upon the Ural Mountains for their crude supply, have already felt very decided results of the Russian-Japanese war, owing to heavy withdrawals of forces from this mountain district by the Russian government, the effect of which has naturally caused an advance in current rates. For some time, there has been an increasing demand for platinum and its alloys in the electrical and chemical fields, which is constantly being supplemented by the increasing use of gas engines, automobiles, and various new electrical appliances, having platinum contacts and attachments. This growing demand, with doubtless a long continuance of the present situation in Russia, would strongly point to a further advance in a very short time.

AN ECHO FROM THE BALTIMORE FIRE.—There is a boy in Baltimore who thinks that the recent fire was not such a bad thing after all. While snooping among the ruins, he came across what the fire had left of a small Crocker-Wheeler motor. He gathered up the castings and wrote to the manufacturers describing his find and closing thus: "Can I wind the armature so as to use it as a direct-current series-wound dynamo? If so, what size and how much wire must I use on the field magnet and armature? How many coils must I divide the armature into? . . . . Thanking you very much for the information you can give me," etc. Many a collector of souvenirs has carried useless things away from the scene of the fire, to be placed in curio-cabinets and on rural mantel shelves, but this young Franklin knows a trick worth two of that.

B. F. STURTEVANT Co.—Since the removal of the foundry and pattern departments from the B. F. Sturtevant Co's. plant at Jamaica Plain to its extensive new quarters at Hyde Park, Mass., the moving of the other departments has progressed in earnest. The fan, heater and electrical departments have already been moved, the engine and galvanized iron departments are in process of removal, and the erection of machines in the machine shop is well under way. These machines, as well as all the others throughout the works, will be of the most modern type and with the systems of cranes and industrial railways will enable the work to be turned out accurately, rapidly and at a minimum cost. The handsome office building is rounding into shape. The headquarters are still at Jamaica Plain, but in a few months the entire plant will be moved.

NATIONAL ELECTRIC COMPANY.—The National Electric Company, successors to the Christensen Engineering Company of Milwaukee, has recently completed and is now occupying a handsome new office building adjoining its shops. The company is about to adopt a plan of providing free dinner for its officers, employees in the executive and the engineering departments, and the heads of the various other departments. Two pleasant dining rooms, a butler's pantry and a kitchen have been fitted up in the new office building. One dining room will be for the officers of the company and its guests. The second will be for the employees of the offices and the engineering department. The new office building is 200 by 66½ feet, three stories in height, the outer walls being of large cement blocks which were manufactured at the plant. The building is absolutely fire proof. Six hundred men are now employed at the works.

BEEBE & BENNETT.—Messrs. Murray C. Beebe and Edward Bennett have, under the above firm name, established general engineering and contracting offices in the Farmers' Bank Building, Pittsburg, Pa. Mr. Beebe was until recently with the Nernst Lamp Company as chemist and technical superintendent, from which company Mr. Bennett has recently severed his connection as chief electrician. Associated with the firm are engineers having a wide experience in the design and construction of railway, light and power plants. The firm is prepared to act as consulting and supervising engineers for the construction of railway, light and power plants, or to contract for the complete erection of such installations. It will examine and report on the mechanical equipment and the methods and systems in use in factories, and submit complete lighting plans for large installations. Examinations and reports will be made of the value of apparatus, properties, or systems.

THE STANDARD UNDERGROUND CABLE COMPANY announces the recent opening of a branch office or headquarters in the Security Building, St. Louis, Mo., in charge of Mr. W. A. Caldwell, who was formerly connected with the Chicago office of the company, but more recently with the home office at Pittsburg. Mr. Caldwell had a number of years' experience with the company in both the construction and sales departments. This company has now seven district or branch offices throughout the country, covering it from Maine to California, namely: The northeastern sales department, Delta Building, Boston, Mass.; the eastern sales department, 56 Liberty Street, New York City, N. Y.; the southeastern sales department, Betz Building, Philadelphia, Pa.; the central sales department, Westinghouse Building, Pittsburg, Pa.; the western sales department, the Rookery Building, Chicago, Ill.; the southwestern sales department, Security Building, St. Louis, Mo.,

WESTINGHOUSE MOTORS.—The Westinghouse Electric & Manufacturing Company has just issued two circulars, Nos. 1077 and 1078, the former relating to type L motors, direct current series wound, and the latter to No. 91 single-phase railway motor and car equipment. The type L motor is widely used for hoisting and other intermittent service requiring large torque. It is well suited for work in mills, foundries and other manufacturing plants. Different applications of this motor are well illustrated, and the principal features of design and construction described. Various curves show the efficiencies, torque, speeds, etc., of different sizes of this type of motor. At the back is a list of the company's circulars in force March 1. The No. 97 single-phase railway motor is described and illustrated in a similar manner in circular 1078, and diagrams show the connections of the apparatus. This motor was described and illustrated in our issue of February 20, last. The advantages of this single-phase railway system are briefly pointed out. Copies of these circulars can be had on application.

THE ELECTRIC STORAGE BATTERY CO., of Philadelphia, is continually adding to its list of Exide battery depots, the list now including twelve cities. These Exide stations instituted for the purpose of the prompt delivery and care of batteries have proven to be of great convenience to the public, and the rapidly increasing demand for batteries has necessitated the opening of new depots at central points. Each of these depots is under the care of an experienced storage battery man, and being stocked with a full line of battery material, users of electric vehicles, equipped with the Exide battery, have at convenient points the same facilities for attention, and procuring supply parts, as they would have if they were at the factory of the company. These stations are located in New York City, 8th Ave. & 49th St.; Philadelphia, 250 North Broad St.; Pittsburg, 5905 Centre Ave.; Buffalo, 200 Pearl St.; Chicago, 204 East Lake St.; Denver, 1510 Court Place; Boston, 39 Stanhope St.; St. Louis, 809 Walnut St.; Rochester, 150 South Ave.; Toledo, 715 Jefferson Ave; Detroit, 265 Jefferson Ave; Columbus, 4th & Gay Sts.

HAULING-IN CABLES.—The Knickerbocker Construction Company, 15 Cortlandt Street, New York, which makes a business primarily of the hauling of heavy electric cables into underground conduits, has acquired the right to use the Grinnell hauling machine, which is a marked improvement on previous devices for this purpose. The apparatus is such that it is easily loaded on cars, and the company is prepared to go anywhere in the United States where the work warrants. It has in its organization competent skilled men in all its branches capable of doing the particular kind of work they will be called upon to do. In addition to the hauling-in of a cable the company makes where necessary the splices in accordance with any specification. It also will lay the conduits, build the manholes, and in short, do the work of complete construction from the excavation and laying of the ducts including manholes and carrying out all details, including drainage to the sewers, gas proofing, etc. Mr. J. W. Cushing, secretary and treasurer of the company, is a Massachusetts Institute of Technology man, and Mr. Whieldon, vice-president and general manager, is a member of the American Institute of Electrical Engineers.

THE BRILLIANT ELECTRIC CO., Cleveland, Ohio, manufacturer of incandescent lamps, has started a novel idea by founding a correspondence course such as would enable anyone taking it thoroughly to operate with efficiency an electric light plant. The company does not propose to issue any text books, but the student is at liberty to buy anywhere for himself such as are recommended. The instruction will consist of reference to standard text books, and answers to personal difficulties as they arise with the individual student. The company says: "The student who obtains valuable information free can certainly not object to our using the backs of letters, etc., for advertising purposes; and it is our intention to give such information in our letters that they will be permanently kept for reference, thus preserving our advertising and bringing it continually to the notice of the engineer." As to the relation of this ingenious plan to its business, the company says: "Incandescent lamps are something that are unfortunately very easily juggled with, but as the buyers or users become more familiar with them, the less opportunity there is for misrepresentation. We base our claims for patronage wholly on the quality of our product; hence our desire to educate the buyer so that he can intelligently discriminate between the good and the poor." The course will be given, however, whether the student purchases Brilliant lamps or not.

THE STANDARD VITRIFIED CONDUIT COMPANY, of 39-41 Cortland Street, New York, completed recently its plant at South River, N. J. Owing to the great demand for conduit manufactured by this company, its plant has run continuously since beginning operations in 1902. In this time an enviable reputation has been gained by its promptness in delivery of a strictly high-grade material. Under patents of Mr. R. W. Lyle, this company is manufacturing multiple duct conduit. It also furnishes free to its customers, with the single duct, its own patented mandrel for laying single duct, which yields great economy in construction. Ample stock of both standard and special sizes together with fittings, kept on hand for delivery on short notice, enables this company to hold its independence in the trade. Forty million feet of conduit annually can be produced by its factories. Among the largest buyers of the Standard vitrified conduit are: The Bell Telephone Co., New York,

Boston and Southern States; Rapid Transit Subway Const. Co., (New York tunnel); Manhattan Elevated, Met. St. Ry. Co., Consolidated Tel. & Elec. Subway Co., New York Edison Co., Brooklyn Edison Co., Brooklyn Rapid Transit Co., Boston Elevated Railway Co., The Philadelphia Edison Co., The Philadelphia Rapid Transit Co., New York Tunnel Co., Westinghouse, Church, Kerr & Co., United Engineering & Const. Co., Western Electric Co., Standard Underground Cable Co., Safety Insulated Wire & Cable Co., Pennsylvania Railroad Co., Baltimore & Ohio R. R. Co., New York Continental Jewell Filtration Co., Hudson River Water Power Co., Glens Falls, N. Y.; Niagara Falls Power Co. The Company's illustrated catalogue, which is a work of art, can be had on application.

CABLE PROTECTION WITH "NIAGRITE."—Electrical power houses carry their currents away from the buildings through conduits or tunnels, and rest the cables on arms or branches usually one branch or arm above another. The over-heating of the wire in the cable sometimes melts the insulating compound and brings two uncoated wires together. This creates a short circuit with the consequent burning and fusing of the wires. This sets fire to the insulation as well as to the outer coating or wrapping, which is usually of cotton braid. The fire is thus communicated to the next cable, which may have been intact, until this trouble set in. This cable is burned from the outside inward again releasing more energy and setting fire to innumerable cables. To prevent this condition, the H. W. Johns-Manville Co., New York, has devised an insulating covering for the cables, which fire-proof these cables so as to prevent, in case of short circuiting of one, the ignition of the others. It was first used by the Niagara Falls Power Co., hence its name "Niagrite." It is made in the following thicknesses-3-32", 1/8", 1/4", 3/8". It is supplied in strips 36" long and 3" wide, and with them is sent sufficient fire-proof glue in which to immerse and coat the strips ready for application. "Niagrite" is absolutely fire proof. The application is easy, and the expense very nominal compared with the amount of protection afforded. Mr. H. W. Buck, electrical engineer of the Niagara Falls Power Co., was the first man to use "Niagrite." He has given orders for about 50,000 lineal feet, and proposes to finish up the remainder of his plant, which will require about 450,000 feet more. The Falls Power Co., of Buffalo, N. Y., also uses it.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 5, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

756,219. WIRELESS TELEGRAPH RECEIVING SYSTEM; Eugune Ducretet, Paris, France. App. filed Aug. 14, 1903. An oscillation transformer whose primary and secondary windings consists of flat spirals superposed one on the other and means for making electrical connection with various parts of each spiral, whereby the number of effective turns is varied.

756,242. ELECTRIC HEATER; Robert Kuhn, Detroit, Mich. App. filed Oct. 7, 1902. A cooling utensil in the form of a double boiler with the heating resistance wound in the intervening space between the two vessels.

756,275. ELECTRIC SIGNALING DEVICE FOR ELEVATORS; Fred S. Payne, Boston, Mass. App. filed Aug. 11, 1903. Details.

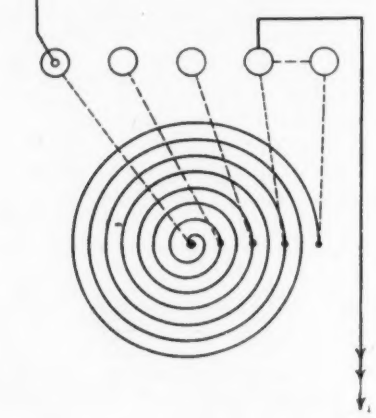
756,316. ELECTROMAGNETIC RAILWAY SWITCH; Rollin A. Baldwin, South Norwalk, Conn. App. filed Dec. 18, 1902. Two solenoids acting upon a single armature to move the switch in opposite directions and cut-outs for automatically throwing the current into the proper solenoid and holding it there until the solenoid has done its work.

756,344. CIRCUIT BREAKER; Leonard L. Elden, Boston, Mass. App. filed June 20, 1901. A plurality of actuating coils and their armatures, one in each circuit liable to be affected by an abnormal current, and tripping mechanism automatically operated thereby for opening the circuit breaker.

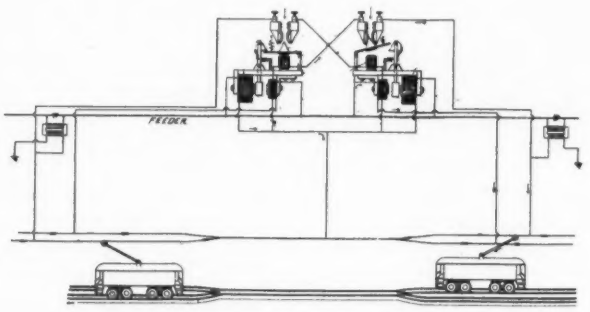
756,408. CALL OR ALARM DEVICE FOR HOTELS OR OTHER BUILDINGS; Harvey Reed, Minneapolis, Minn. App. filed Sept. 4, 1902. Details.

756,412. SUPPORT FOR INCANDESCENT ELECTRIC LAMPS; Adolphe Romain and Jean D'Ayguesvives, Paris, France. App. filed Oct. 10, 1902. One or more sockets are attached to a central fixture in which the fuses are located.

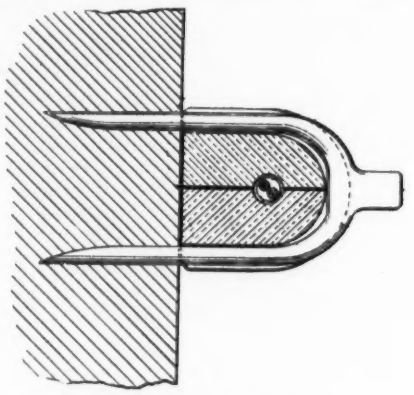
756,445. RHEOSTAT; Henry J. Wiegand, Milwaukee, Wis. App. filed June 1, 1903. A base provided with a central projection and a rim, and having an annular recess in which the contact plates and resistance coils are located and covered by a suitable insulating material.



756,219.—Wireless Telegraph Receiving System.



756,511.—Electric Railway.



756,627.—Insulator.

756,460. ELECTRIC ARC LAMP; Andre Blondel, Paris, France. App. filed Nov. 10, 1902. The fumes produced by mineral electrodes are carried away by suitable ventilating passages to prevent their access to the lamp mechanism.

756,511. ELECTRIC RAILWAY; Thomas D. Lovell, Beverly, Mass. App. filed Nov. 3, 1903. A safety system for single track roads in which the entrance of a car to a block automatically cuts off current from a section of the trolley wire at the opposite end of the block to prevent a car entering from the opposite direction.

756,516. AUTOMATIC ELECTRIC CUT-OUT; Guy Milburn, Baltimore, Md. App. filed March 31, 1903. Details.

756,523. AUTOMATIC POWER CUT-OUT FOR ELECTRIC RAILWAYS; Harry F. Pieper, New York, N. Y. App. filed Jan. 5, 1904. An arrangement of circuits and apparatus by which a car on a block using either power current or lamp current will prevent the entrance of another car to the same block from behind, by taking current therefrom.

756,534. CIRCUIT CONTROLLER; Jacob L. Schureman, Jr., Chicago, Ill. App. filed Jan. 11, 1904. The arm of a rheostat has a lost-motion connection with a dash-pot, permitting it to quickly close the circuit on the first point and thereafter move slowly over the succeeding points to cut out the resistance.

756,541. ELECTRIC SWITCH; Peter Sorensen, Brooklyn, N. Y. App. filed Nov. 23, 1900. A clock-actuated switch capable of a quick break and a quick make of the circuit.

756,547. TROLLEY POLE; Edwin A. Wakefield and George W. Morse, Mechanic Falls, Me. App. filed Dec. 18, 1903. Mechanism for lowering the pole in case it rises above the wire.

756,550. TROLLEY; Charles M. Wilson, St. Louis, Mo. App. filed Feb. 18, 1904. A spiral groove formed at each side of the contact groove of the trolley roller to conduct the wire when displaced back to the center.

756,605. CURRENT REGULATORS; Emil Dysterud, Monterey, Mex. App. filed June 9, 1903. A liquid tank having two compartments and a valve in the separating partition which is moved automatically to vary the body of liquid standing in the opening to vary the current which may travel through the liquid between two electrodes located in the respective compartments.

756,608. ANNUNCIATOR; Franklin H. Elwell, Chicago, Ill. App. filed July 9, 1902. Details.

756,627. INSULATOR; John A. Hanson and Albert F. Lambert, Davenport, Wash. App. filed June 14, 1902. A two-part insulator block between the parts of which the conductor is confined and which are held in position by a straddling staple driven into the supporting wall.

756,665. APPARATUS FOR TESTING THE INSULATION OF THE COILS OF ELECTROMAGNETS; James Lindsey, Fall River, Mass. App. filed Feb. 1, 1904. An electric buzzer for determining by means of the resulting difference in sound, the comparative quality of the insulation of a coil with that of a standard sounding coil.

756,676. WAVE RESPONSIVE DEVICE; Frederick W. Midgley, Philadelphia, Pa. App. filed Nov. 10, 1902. The device comprises two masses of similar or dissimilar composition, one of them having a coating of oxide, while the other is burnished.

756,711. ELECTRIC CONTROLLER FOR ALTERNATING CURRENTS; Robert P. Rukenbrod, Turtlecreek, Pa. App. filed Jan. 26, 1903. Details.

756,718. WIRELESS SIGNALING SYSTEM; Harry Shoemaker, Philadelphia, Pa. App. filed Aug. 9, 1902. A system for receiving wireless signals which depends upon the change of resistance of a conductor due to the heat produced in it by the arriving energy.

756,719. SIGNALING SYSTEM; Harry Shoemaker, Philadelphia, Pa. App. filed Aug. 19, 1902. A method patent relating to the subject of the preceding patent.

756,720. WIRELESS SIGNALING SYSTEM; Harry Shoemaker, Philadelphia, Pa. App. filed June 25, 1903. The invention consists in supplying to a freely oscillating circuit, direct current energy and employing the energy of the high frequency oscillations resulting in the oscillating circuit for any purpose whatsoever.

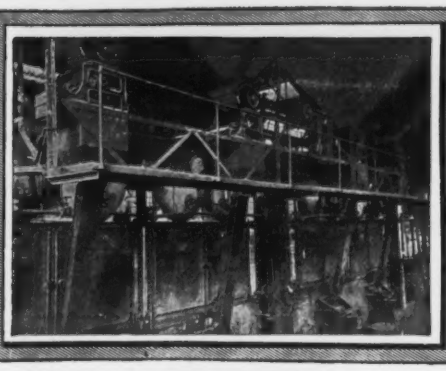
756,724. INSULATORS; John C. Snodgrass, Steubenville, Ohio. App. filed Aug. 26, 1903. An insulating block having a V-shaped projection partially entering a similarly shaped orifice to hold a stretched conductor in a deflected condition within the insulator.

756,757. THIRD RAIL ELECTRIC RAILWAY SYSTEM; John D. Wilkins, Chicago, Ill. App. filed July 24, 1903. A covering for a third rail consisting of a string piece made in two longitudinal sections bolted together.

756,777. ELECTRICAL ANNUNCIATOR; Albert Carliss, Chicago, Ill. App. filed Oct. 5, 1901. Details of construction.

756,782. CIRCUIT BREAKER; Leonard L. Elden, Dorchester, Mass. App. filed Dec. 10, 1903. Details of construction of the tripping mechanism.

756,793. ELECTRICAL INDUCTION MACHINE; Hans Lippelt, New York, N. Y. App. filed Jan. 13, 1903. A construction of machine intended to avoid sparking at the collectors.



AUTOMATIC SCALES

Coal Scales in a POWER STATION

Efficiency of boilers seen at a glance

RICHARDSON SCALE CO.
19 Park Row N.Y. City.

ATLANTIC INSULATED WIRE & CABLE CO.

WIRES AND CABLES.

FOR SUBMARINE, AERIAL, UNDERGROUND AND INTERIOR USE.

FACTORY. STAMFORD. CONN.

120 LIBERTY STREET, NEW YORK CITY.

HENRY C. TOWNSEND
Formerly Principal Examiner Electrical Division U. S. Patent Office.
DELBERT H. DECKER
Late Assistant Examiner Electrical Division U. S. Patent Office.
TOWNSEND & DECKER Solicitors of U. S. and Foreign Patents
141 Broadway, New York.
Expert Opinions on the scope and validity of Patents

FOR CARD INDEX
ELECTRICAL WORLD AND ENGINEER APRIL 9, 1904

A. I. E. E. International Electrical Congress Reception Committee	680
Incandescent Lamp Combination	680
Steam Turbine and Other Features of The Port Huron Light and Power Company's Station. By James E. Davidson	681
An Important Trolley System in New Jersey	686
Booster Calculations. By Wm. A. DelMar	687
High Tension Discussion in Chicago	690
Synchronous Converters. By F. G. Baum	691
The Telephone Substation—III. By Arthur V. Abbott, C. E. (Concluded.)	695
Steam Turbine Economy. By A. M. Mattice	700
British Technical Education. By Wm. A. DelMar	700
Digest of Current Electrical Literature	701
Recovery of Cylinder Oil. By Thos. Griswold, Jr	706
Storage Battery Installation at Binghamton, N. Y	706
Launch Motors and Controllers	707
Data on the Marconi Wireless Telegraph System	707
Rubber Compound for Electrical Purposes	707

WM. A. ROSENBAUM
PATENT ATTORNEY
140 Nassau St., New York City
(Formerly in the Times Building)

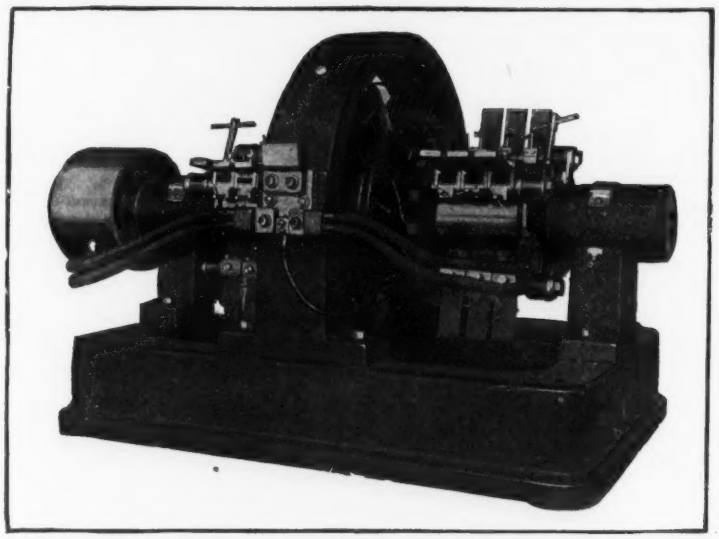
PATENTS
Law Offices
OF
DYER & DYER
31 Nassau Street
NEW YORK CITY
Patent Soliciting and Litigation
Electrical Cases a Specialty

THOMAS J. JOHNSTON
COUNSELLOR AT LAW
11 Pine St., NEW YORK CITY
Patent Causes Patent Soliciting

LAVA INSULATORS machined into any shape
CORRESPONDENCE SOLICITED
P. J. KRUESI, Chattanooga, Tenn.

"AMERICAN"
STORAGE CELLS Are the Best
Send for Descriptive Circular
AMERICAN BATTERY CO.
172 So. Clinton St. Chicago, Ill.
Established 1889

Electrolytic Generators
MULTI-POLAR and BI-POLAR



Electro-Plating, Electrotyping and Deposition of Metals.
100 TO 2,500 AMP. 5 TO 6 VOLTS
CHAS. J. BOGUE,
209 Centre Street - - NEW YORK CITY
Tel. 2111 Spring. Cable Address, Machelect, N. Y.

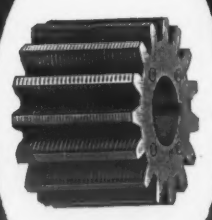
WRITE FOR OUR CATALOGUE OF
ELECTRICAL BOOKS

GENUINE HARD PORCELAIN
EMPIRE CHINA WORKS
144 TO 156 GREEN STREET. (GREENPOINT) BROOKLYN, N. Y.
FOR ELECTRICAL SPECIALTIES

GOEPEL & NILES
COUNSELORS AT LAW
REGISTERED PATENT ATTORNEYS
U. S. and Foreign Patent Trade Marks, Copyrights
290 Broadway, Dun Bldg., New York.

ELECTRICAL WORLD and ENGINEER
is more widely quoted abroad than any other electrical journal published

"LAVITE"
THE SUPERIOR INSULATING MATERIAL.
WRITE FOR BOOKLET
The D. M. Steward Mfg. Co.
Chattanooga, Tenn.
NEW YORK, 8 Jay St. (1)



Stop That Noise!

New Process Pinions will do it. There is no ring to rawhide, so they can't make the racket that metal gears do. And New Process rawhide wears like iron. Get our booklet.

The New Process Raw Hide Company,
SYRACUSE, N. Y.

POSITIONS WANTED.

The rate for "Position Wanted" advertisements of forty words or less is one dollar an insertion; additional words two cents each, payable in advance. Remittance and copy should reach this office not later than Tuesday morning for the next succeeding issue.

POSITION WANTED. — By electrical engineer and chief draftsman; experienced in calculation, design and construction of D. C. and A. C. generators, motors and appliances; desires change of position; Cornell graduate with nine years' practical experience and excellent references. Address No. 1406, care Electrical World and Engineer, New York.

POSITION WANTED.—With a consulting engineer by a Cornell graduate with practical experience in the testing department of the General Electric Co.; age 31; long business; will offer services for a reasonable amount. Address No. 1368, care Electrical World and Engineer, New York.

POSITION WANTED.—By chief electrical engineer of company manufacturing dynamos and motors (direct current) from 1 to 500-K.W; desires to change location; successful designing experience, having been engaged in electrical business for past 11 years; age 33 years; married; splendid recommendations from present employers. Address No. 1414, care Electrical World and Engineer, New York.

POSITION WANTED.—By electrical engineer, 27 years of age; college education; speak several languages; no objection to leaving United States. Address No. 1423, care Electrical World and Engineer, New York.

POSITION WANTED.—Now employed as superintendent of construction, and would be pleased to entertain an offer from another firm in same capacity; could entertain a proposal to manage a small construction and supply concern. Address No. 1427, care Electrical World and Engineer, New York.

POSITION WANTED.—By young man of 26, with consulting, electrical engineer, anywhere between Chicago and Pacific coast; graduate of first-class technical institute; one year with General Electric Company; now with large steel manufactory. Address No. 1428, care Electrical World and Engineer, New York.

YOU NEED IT!

Gale's Commutator Compound

The only Article that will Prevent Sparking

Will keep the commutator in good condition and prevent cutting. Absolutely will not gum the brushes. 50c. per stick. $3.00 per dozen. *Send 50c. for trial stick.*

FOR SALE BY ALL SUPPLY HOUSES, OR (1)

K. McLENNAN & CO. SOLE MANUFACTURERS 909, 100 Washington Street, CHICAGO

FLASHING SIGNS ARE SEEN.

They always attract attention.
They bring business to the user.
They increase the opportunities for supply dealers, contractors and central station men to do business.
They increase the number of current users.
The REYNOLDS FLASHER is a proven success.

REYNOLDS ELECTRIC FLASHER MFG. CO.
221-225 FIFTH AVENUE, CHICAGO, ILL.

IF YOU WANT AN ARTICLE THAT WILL REPEAT ITSELF.
TRY U.S. METAL POLISH
FOR POLISHING ALL KINDS OF METALS.
Sold by Dealers. Samples Free.
Geo. W. Hoffman, MANUFACTURER. 295 E. Washington St., Indianapolis, Ind.

MECHANICAL DRAWING AND DESIGN

$3 Postpaid

Rogers' Drawing and Design gives a thorough and comprehensive self-instruction course in the principles and practice of Drawing and Designing required in the shops and drafting rooms of the engineering, electrical, machinery and kindred trades.

506 pages, 610 illustrations. Clearly printed on superfine paper and handsomely bound in black vellum cloth, with full gold edges. *The money paid will be refunded if the book is not found to be satisfactory.*

THEO. AUDEL & CO., Educational Book Publishers, 63 Fifth Ave., New York

Specimen pages and a complete list of contents sent postfree upon request

POSITION WANTED.—As superintendent or superintendent's assistant on construction work; college education; experience as foreman for inside and outside construction for light and power, high and low tension, as well as designing sub-stations; speaks four languages; will go anywhere; at present in charge of the electric construction for a mine and mining town. Address No. 1424, care Electrical World and Engineer, New York.

POSITION WANTED.—By young electrical engineer; wants responsible position in a cable manufacturing company; five years' practical experience in all methods of testing, manufacturing and estimating; will submit fuller particulars; New York vicinity preferred. Address No. 1425, care Electrical World and Engineer, New York.

POSITION WANTED.—By American, 22; student of the second year class of science at Cooper Union, with four years' experience in machine shops; desires position with some electrical engineering or other concern where he would be in line for electrical engineering. Address No. 1426, care Electrical World and Engineer, New York.

POSITION WANTED.—By a young married man as superintendent of lighting system; all round practical man; seven years' experience on direct and alternating systems, any type electrical and steam appliances; a hustler, efficient, steady and reliable; good references; Central States preferred. Address No. 1421, care Electrical World and Engineer, New York.

POSITION WANTED.—By an American electrical engineer at present in South America under contract with an American company to report on electrical properties; desires similar or other commissions before returning; facilities and qualifications unequaled. Address C. W. C., 52 West 53d St., New York City.

POSITION WANTED.—By young man, 32, as superintendent or foreman on general electrical construction; nine years' practical experience, direct or alternating current; up on sub-station 3-phase system; held civil service position; expert electrician, passing with average 94 per cent.; any location. R. I. C., care Electrical World and Engineer, 1139 Monadnock Bldg., Chicago.

(*Continued on page 59.*)

ALTERNATORS—60 CYCLES

1100 or 2200 Volts.

	Lt.	
2	300	Gen. Elec., 15-K.W., comp., single phase.
1	500	Wood, 25-K.W., comp., single phase
1	600	West., 30-K.W., comp., single phase
1	750	Wood, 37½-K.W., comp., single phase
1	900	West., 45-K.W., comp., 2 phase.
1	1200	West., 60-K.W., single ph., comp.
1	1500	Warren-Medberry, 75-K.W., 2 ph., ind. type
1	1500	Stan., inductor, 75-K.W., 2 ph.
1	1500	West, 75-K.W., comp., distributed winding, 2 ph.
1	1500	West., 75-K.W., 2 ph., 2200 v., d. c. to 14x14 Gates 4-valve aut. engine
1	1500	Wood, 75-K.W., comp.
1	2400	Gen. Elec., 120-K.W., 3 phase, 2200 or 3300 v.
1	7200	Gen. Elec., 360-K.W., 3' phase, 2300 volts
1	3000	Westinghouse, single phase, 150-K.W., 2200 volts, latest type, direct connected to 12x24x14 Harrisburg tandem compound self-oiling engine, complete with exciter and switchboard panel, speed 257

ALTERNATORS—125-133 CYCLES.

	Lt	
1	650	Wood, 33-K.W., comp.
1	750	West., 37½-K.W.
1	750	Wood, 37½-K.W., comp.
1	900	Warren-Medberry, 45-K.W., inductor type
1	1000	Wood, 50-K.W., comp.
2	1200	West., 60-K.W., toothed armt., comp.
1	1500	Wood, 75-K.W., comp.
1	1500	Stanley, inductor type, 75-K.W., 1100 or 2200 v., 2 phase.
1	2400	Gen. Elec., 120-K.W., type A 120, latest type, comp., toothed armt.
2	2400	Gen. Elec., 120-K.W., type A S, comp., slotted armt.
2	2400	West., 120-K.W., comp., self-oiler, toothed armt.
2	3000	Stanley inductor type, 150-K.W., 1100 or 2200 v., 2 phase.
1	8000	West., 400-K.W., slotted armt., 3 bearings, distributed windings

110 TO 125 VOLT GENERATORS.

DIRECT CURRENT.

	Lt.		Speed.
6	10	Towle, M. P., compound	2000
2	12	Edison, self-oiler	2700

LATEST TYPES OF (second-hand) ELECTRICAL MACHINERY

FOR SALE AT BARGAIN PRICES

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO.

Send for our Monthly Bargain Sheet showing complete list of apparatus with NET PRICES. All machines fully guaranteed.

	Lt.		Speed.
1	15	Wagner, 15 amp., M.P. 50 v.	1800
1	30	General Electric, type C A	2100
2	35	Hobart, M. P., comp.	1600
1	40	Roth, M. P., comp., direct connected to Drake engine	800
1	45	Lundell	1800
3	45	Westinghouse, M. P., comp	1800
1	50	Crocker-Wheeler, self-oiler	1150
2	50	Northern, M. P., compound	2050
1	50	Westinghouse, M. P., comp.	1150
2	60	Hobart, M. P., comp., s-o.	1200
1	75	Westinghouse, M. P., comp.	1600
1	75	Phoenix, comp., direct connected to No. 4 Case engine	650
1	80	Fort Wayne, multipolar	1600
1	80	Crocker-Wheeler	1000
1	80	Riker, M. P., comp., s-o.	1100
1	80	Perrett, multipolar	950
1	100	Triumph, M. P., comp.	1250
1	100	Card, M. P.	1000
2	110	Commercial, M. P., comp.	1600
1	150	Edison, comp.	1700
1	150	Eddy, M. P.	1650
1	150	Western Elec., M. P.	1600
1	150	General Electric, M. P.	1400
1	160	Triumph, M. P., compound	1200
1	160	Northern, M. P., compound	900
1	165	Am. Engine Co., M. P.	1400
1	210	Edison, self-oiler, 12-K.W.	1600
1	210	Phoenix, M. P., comp.	1650
1	210	Eddy, M. P.	1100
1	225	Card, M. P., comp.	690
1	260	Commercial, M. P., comp.	1100
1	300	Phoenix, M. P.	1100
1	300	Perrett, M. P., comp.	750
1	300	Ahlms-Edwards, M. P., comp.	825
2	300	Gen. Electric, M. P., comp.	1100
1	300	Western Elec., M. P., comp.	750
2	350	Edison, 20-K.W., comp., s-o.	1400
2	350	C. & C., M. P.	800
1	350	Card, M. P., enclosed	800
1	400	Northern, 22½-K.W., M. P., comp.	1000
1	400	Crocker-Wheeler, M.P, comp.	875
2	400	Westinghouse, M. P., comp.	975
2	450	Edison, 25-K.W., self-oiler	1300
2	450	Commercial, M. P., comp.	1000
1	450	Quaker City, M. P., comp.	1000
1	450	Triumph, M. P., comp.	750
2	450	Sprague-Lundell, M. P., comp	875
1	450	Eddy, M. P., comp.	950
1	450	Gen. Electric, M. P., comp.	1050
1	450	Western Elec., M. P., comp.	650
1	540	Edison, comp., 30-K.W.	1200
1	540	C. & C., M. P., 30-K.W.	700
1	540	Elwell-Parker, M. P., comp.	600
2	540	Gen. Elec., M. P., comp. 30-K.W.	1000
3	600	Card, M. P., compound	750
1	650	Milwaukee, M. P., comp.	650
1	650	Westinghouse, M. P., comp.	900
1	650	Westinghouse, M. P., 35-K.W., engine type, direct connected to 10x10 enclosed self-oiling Buffalo Forge engine, class A, upright	350
2	700	Commercial, M. P., comp.	865
1	700	Card, M. P., compound	750
1	700	Crocker-Wheeler, M. P., comp.	1085
1	900	Wagner, M. P., comp., 50-K.W.	950
1	1000	Edison, s-o., 60-K.W., comp.	700
1	1000	Gen. Elec., 6 pole, comp., direct connected to 12x13 Weston automatic engine, 60-K.W.	275
1	1100	Triumph, M. P., comp., 65-K.W.	850
1	1300	Card, M. P., comp., 75-K.W.	500
1	1350	Waddel-Entz, 80-K.W., d. c. to Armington & Sims 15½x14 engine	265
1	1350	Ft. Wayne, comp., direct connected to 13x14 Buckeye vertical engine, 80-K.W.	275
2	130	Gen. Elec., M. P., 6 pole shunt, direct connected to Ames tandem comp. 11x17x12 automatic engine	270
2	1800	Edison, 100-K.W., s-o., comp.	650
1	1800	Western Electric, M. P., comp., 6 pole, 100-K.W.	425
1	2200	Western Electric, M. P., 125-K.W., latest type, comp., 6 pole, 3 bearing. (Above machine can be arranged for direct connection also.)	225
2	2500	Western Electric, M. P., comp., 150-K.W., direct connected to 16x18 McEwen engine	240

220 TO 250 VOLT GENERATORS.

	K.W.		Speed.
1	7½	Holtzer-Cabot, compound	1350
1	9	New England, M. P.	1600
2	10	T.-H., D 10, oil cups	1600
1	12	Western Elec., M. P., comp.	750
1	15	Edison, self-oiler	1500
1	17½	Kester, comp.	1350
1	17½	Eddy, type C, comp.	1450
1	20	Edison, self-oiler, comp.	1400
1	20	Western Electric, comp., s-o.	700
1	20	Keystone, M. P., comp.	950
1	20	Eddy, M. P., comp.	825
1	20	Western Elec., M. P., comp.	650
2	30	C. & C., comp., self-oilers	800
1	40	C. & C., multipolar, comp.	750
1	40	Eddy, M. P., comp.	875
1	40	Commercial, M. P., d. c. to 11x12 automatic Chandler-Taylor engine	300
1	45	Edison, comp., self-oiler	1000
1	45	Am. Engine Co., M. P., comp.	700
1	45	Western Elec., M. P., comp.	550
1	45	C. & C., M. P., comp.	700
1	45	Gen. Elec., M. P., comp.	925
1	50	C. & C., compound	800
1	50	Commercial, M. P., comp.	775
1	50	Maine, M. P., compound	600
1	55	Fuller, multipolar, comp.	750
1	55	Eddy, M. P., comp.	750
1	60	Sprague, compound	500
1	60	Northern, M. P., comp.	800
1	75	Siemens & Halske, Churchward type, M. P., direct connected to 14x14 Ideal engine	300
1	80	C. & C., comp., self-oiler	625
1	100	Edison, comp., self-oiler	650
1	100	Commercial, M. P., comp.	675
1	125	Eddy, M. P., comp.	700
2	150	National, M. P., comp.	350
1	200	Eddy, multipolar, compound	500
1	250	Western Electric, 6 pole, type L, 3 bearing, compound	450
1	300	Western Electric, M. P., brand new	480

DYNAMOS ❁ MONEY SAVERS ❁ ENGINES

DIRECT CONNECTED UNITS

1500-K.W 600 volts, Westinghouse generator and Allis Corliss c. p. engine.
4—375-K.W. Westinghouse, 550 volts, and Westinghouse compound engine.
1—300-K.W. Stanley 60 cy. 2 hp., 2400 v. and McIntosh & Seymour vertical c. p. engine.
1—300-K.W. G. E., Monocycle, 60 cy., 2300 v. and McIntosh & Seymour tandem engine.
2—150-K.W. Westinghouse single ph., 60 cy. and Harrisburg tandem engines.
2—125-K.W. General Electric, 250 v. (brand new) and any engine you desire.
80-K.W. Jenney, 6 pole, 125 v. and Russell 4-valve engine.
2—50-K.W. American Ball, 220 volts and American Ball engines.
1—50-K.W. Walker, 125 volts and Russell engine (new).
2—42-K.W. Westinghouse, 220 volts, and Alfrey engines.
30-K.W. Eddy, 125 volts, and Watertown engine.
25-K.W. Westinghouse, 125 volts, and Westinghouse engine.
7½-H.P. Northern, 125 v., and Hill vertical engine (new).
6-K.W. Northern, 125 volts, and Hill vertical engine (new).
4-K.W. Northern, 125 volts, and Hill vertical engine (new).
3-K.W. Northern, 125 volts, and Hill vertical engine (new).

BELTED UNITS

2—500-K.W. Westinghouse, 550 v., and Cooper Corliss engines.
2—300-K.W. G. E., 550 v., and Cooper Corliss engines.
1—150-K.W. Westinghouse, 550 volts, and 18½x18 A. L. Ide engine.
1—110 K.W. G. E., 6 pole, 550 volts, and 11x17x14 Harrisburg tandem engine.
1—250-K.W. Westinghouse, 2 ph., 60 cy., 2200 v., and 17x28x18 Harrisburg tandem engine.
1—100-K.W. G. E., 60 cy., 3 ph., 2200 v., and 11x17x14 Harrisburg tandem engines.

500 VOLT GENERATORS

2—500-K.W. Westinghouse, 4 pole.
2—300-K.W. General Electric, 4 pole.
1—150-K.W. Westinghouse, 4 pole.
1—110-K.W. General Electric, 6 pole.
2—100-K.W. General Electric, 4 pole.
2—100-K.W. Edison bipolar.
1—75-K.W. Westinghouse, 4 pole.
2—75-K.W. General Electric, 4 pole.
3—D-62-K.W. Thompson-Houston.
2—60-K.W. Edison bipolar.

220-250 VOLT GENERATORS

175-K.W. Eddy, 4 pole.
75-K.W. T. H., bipolar.
40-K.W. Crocker-Wheeler, 4 pole.

110-125 VOLT GENERATORS

2—66-K.W. General Electric, 4 pole.
2—60-K.W. Edison bipolar.
2—45-K.W. Edison bipolar.
1—30-K.W. General Electric, 4 pole.

ENGINES

16 and 30x48, Hamilton tandem.
3—11x17x14 Harrisburg tandem.
11x19x24 Buckeye tandem.
24x48 Wright of Newburgh.
16x38 Watts-Campbell Corliss.
2—13x12 Erie Ball automatic.
2—9½x10½ McIntosh & Seymour.
1—8½x8 Westinghouse.

BOILERS

540-H.P. Sterling 150 lbs. pressure.
4 Return tubulars, 72″x18′, 120 lbs.

Boilers THOMPSON SON & CO., 114 LIBERTY ST., N. Y. Equipments

MODERN ELECTRICAL MACHINERY FOR SALE.

DIRECT CONNECTED UNIT, 220 Volts

50-K.W. American Ball Dynamo & Engine.

110 VOLTS DIRECT CURRENT
Dynamos or Motors

30-K.W. Bullock, M. P.
15-K.W. Eddy, M. P.
10-K.W. Eddy, M. P.
5-K.W. C. & C.
3-K.W. C. & C.
2-K.W. Lundell.
1-K.W. C. & C.

500 VOLTS DIRECT CURRENT
Dynamos or Motors

15-H.P. General Elec., M. P.
7½-H.P. General Elec., M. P.
5-H.P. Sprague.
2-H.P. General Elec.

220 VOLTS DIRECT CURRENT
Dynamos or Motors

40-H.P. Sprague, M. P.
25-H.P. Crocker-Wheeler, M. P.
20-H.P. Card.
15-H.P. Sprague, M. P.
10-H.P. General Elec.
10-H.P. Holtzer Cabot.
7½-H.P. Card.
7½-H.P. Edison.
7½-H.P. C. & C.
5-H.P. Paragon, M. P.
5-H.P. Holtzer Cabot.
5-H.P. Crocker-Wheeler.
3-H.P. Diehl.
3-H.P. C. & C.
2-H.P. General Elec.
2-H.P. Diehl.
1½-H.P. C. & C.
1-H.P. Crocker-Wheeler.

ALTERNATING INDUCTION MOTORS

2 Phase, 60 Cycles, 220 Volts

30-H.P. Type F Westinghouse.
15-H.P. Type C Westinghouse.
10-H.P. Type C Westinghouse.
7½-H.P. Type C Westinghouse.
5-H.P. Type C Westinghouse.
2-H.P. General Elec.
1-H.P. Westinghouse.
½-H.P. General Elec., 220 or 110 v.
¼-H.P. General Elec.

2 Phase, 440 Volts, 60 Cycles

30-H.P. Westinghouse.
15-H.P. Westinghouse.
10-H.P. Westinghouse.
7½-H.P. Westinghouse.
5-H.P. Westinghouse.
3-H.P. Westinghouse.
1-H.P. Westinghouse.

3 Phase, 60 Cycles

5-H.P. Westinghouse, 220 volts.
2-H.P. Gen. Elec., 110 volts.
2-H.P. Westinghouse, 220 volts.
½-H.P. General Elec., 220 volts.
½-H.P. General Elec., 110 volts.

1 Phase, 60 Cycles

7-H.P. Wagner, latest type.
½-H.P. General Elec.
¼-H.P. General Elec.

1 Phase, 125 Cycles

3-H.P. Wagner, latest type.
1-H.P. General Elec.
½-H.P. Emerson.
1/10-H.P. Emerson.

Large stock of small motors, autostarters, starting boxes, rheostats, switchboards, voltmeters, ammeters, etc.

I BUY, RENT AND INSTALL.—GEORGE BENDER, 137 CENTRE STREET, NEW YORK.

ELECTRIC LOCOMOTIVES.

	Ton.	
1	10	Morgan-Gardner, type M, 250 v., direct current, double motor locomotive, 74-K.W., 42-inch gauge, speed 6 to 10 miles per hour
1	17	Morgan-Gardner, type N, 250 v., direct current, double motor locomotive, 115-K.W., 40-in. gauge, speed 8 miles per hour

500 TO 550 VOLT GENERATORS.

	K.W.		Speed.
1	60	Edison, comp., self-oiler, new armt. and commutator	800
1	62	T.-H., D 62, s-o., comp.	900
1	75	Akron, M. P., 6 pole	900
1	75	Bullock, multipolar	900
2	75	General Electric, M. P. 4, comp., new rewound	700
1	100	Siemens & Halske, 4 pole, with bar-wound armature, compound	600
2	100	Edison, compound	650
1	100	Gen. Elec., M. P. 4, comp.	650
1		General Electric slate panel switchboard for above, complete with ammeter, circuit breaker and resetting device, main line switch, rheostat switch, bus-bar connections, etc.	
2	120	Westinghouse, M. P., comp.	625
1	200	Thompson-Ryan, M. P., comp., three bearings	525
1	200	General Electric, M. P. 4, comp., s-o., 3 bearings, new commutator	400

ARC DYNAMOS.

	Lt.	C.P.		Speed.
1	35	2000	T.-H., L D 2 ball	820
1	45	1200	Brush, No. 7	1050
1	50	1200	T.-H., L D 12, new ball	820
2	50	2000	T.-H., M. D 2, s-o., ring	820
1	65	2000	Brush, No. 8	950
1	75	1200	T.-H., M D 12, s-o.,	820
1	75	1200	Wood	950
1	100	2000	Wood	600
1	125	1200	Brush, 6.6 amp.	700
2	125	2000	Brush, 9.6 amp.	500
1	125	1200	Excelsior	700

220 TO 250 VOLT MOTORS.

	H.P.	DIRECT CURRENT.	Speed.
1	1	General Electric, type I B	1025
1	1½	Commercial, self-oiler	1200
1	2	Lundell, newly rewound	1000
1	2½	Riker, s-o., with extra armt.	1460
1	3	C. & C.	1400
1	3	Bernard, M. P.	1525
1	3	Gibbs, M. P.	1400
1	3	Lundell, self-oiler	1500
2	1	General Electric, 110 volts	1800
3	3	Western Electric, M. P.	1000
3	3	Westinghouse, M. P.	1700
1	3	Storey, variable speed	300-1500
1	3½	Eddy, M. P.	400
1	4	Commercial, M. P.	450
2	5	Gibbs, M. P.	1400
3	5	Hobart, M. P.	1050
5	5	Western Electric, M. P.	950
1	5	Eddy, M. P.	300
3	5	Belknap, M. P.	230
2	5	Crocker-Wheeler special printing press motors, direct con.	318
1	6½	Jenny, M. P., back geared, speed of shaft	440
1	7½	Waddell-Entz, M. P.	900
1	7½	Edison	1350
1	7½	Towle, M. P.	1600
1	7½	Western Electric, M. P.	1150
2	7½	Western Electric, M. P.	950
1	7½	Milwaukee, M. P., series, crane type, grease cup	600
1	8	Holtzer-Cabot	1250
1	8	Crocker-Wheeler, series, crane type	900
1	8	Maine, M. P.	200
1	10	Standard, M. P.	670
1	10	C. & C., M. P., enclosed	1100
1	10	Keystone, M. P., enclosed	1175
1	10	Western Electric, M. P.	800
1	10	Story, M. P., enclosed	600
2	10	Westinghouse, M. P.	1250
3	10	Bernard, M. P.	130
1	12	C. & C., self-oiler	1100
1	15	Keystone, M. P.	1570
1	15	New England, M. P., 8 pole	650
1	15	Western Electric, M. P	625
1	18	Edison, 15 K.W.	1150
1	20	Eddy	1300
1	20	Kester	1250
2	25	Edison, self-oilers	1100
1	25	Western Electric	525
1	25	Keystone, M. P.	850

BARGAINS IN (second-hand) ELECTRICAL MACHINERY

We do not offer old, worn out machines fit for the Junk pile, but the LATEST TYPES of the leading manufacturers.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO.

Send for our Monthly Bargain Sheet showing NET prices—all machines fully guaranteed.

	H.P.		Speed.
1	25	Eddy, M. P.	725
1	25	Western Electric, M. P.	550
2	40	C. & C., self-oilers	650
1	40	Sprague-Lundell, M. P.	625
1	50	C. & C. multipolar	650
1	50	Eddy, M. P.	675
1	50	Am. Engine Co., M. P.	565
1	60	C. & C., self-oiler	600
1	60	Edison, self-oiler	750
1	60	Commercial, M. P.	600
1	60	C. & C., M. P.	560
1	60	Maine, M. P.	500
1	60	Western Electric, M. P.	425
1	60	General Electric, M. P.	800
1	65	Eddy, M. P.	650
1	70	Fuller, multipolar	600
1	75	Sprague, self-oiler	450
1	75	Northern, M. P.	700
1	85	Western Electric, self-oiler	500
1	100	C. & C., self-oiler	450
1	125	Edison, self-oiler	550
1	135	Commercial, M. P.	675
1	150	Eddy, M. P.	600
2	200	National, M. P.	300

500 TO 550 VOLT MOTORS.

	H.P.		Speed.
1	1	General Electric, C. A.	1200
1	1½	Belknap, self-oiler	1700
2	1½	Northern, series	1400
2	1½	Crocker-Wheeler	1550
1	2	Maine, M. P.	1100
1	2½	Bain, self-oiler	2100
1	2½	New England	1500
1	3	C. & C., self-oiler	1600
1	3	General Electric, type C E	1800
1	3	Maine, M. P.	1100
1	3	Jenney, M. P., back geared, speed of shaft	240
1	3½	Roth	1700
1	3½	Roth, M. P.	950
1	3½	Westinghouse, M. P.	1050
1	4	Edison, 3 K.W.	1700
4	4	Maine, multipolar	550
1	4	Bernard, M. P.	550
1	5	Hobart, self-oiler	1600
1	5	Fort Wayne	1400
2	5	Triumph, M. P.	1250
3	5	Crocker-Wheeler	950
1	6	C. & C., enclosed	1030
2	6	T.-H., D 5, self-oilers	1800
2	7½	Thomson-Houston, D 7½	1600
1	7½	Roth, self-oiler	1400
1	7½	Card, multipolar	775
1	7½	Jenney, M. P.	1500
1	7½	C. & C., M. P., compound	1160
3	7½	Crocker-Wheeler	1500
1	7½	Eddy, M. P.	875
1	10	Phoenix, M. P.	950
1	10	Crocker-Wheeler	1275
1	10	Northern, M. P.	1350
1	10	Triumph, M. P.	1100
2	10	General Electric, M. P.	1400
1	10	Perrett, M. P., compound	600
1	10	Eddy, M. P.	650
3	10	Belknap, M. P.	500
1	12	Am. Engine Co., M. P.	1365
1	15	Eddy, self-oiler	1725
1	15	C. & C., self-oiler	975
1	15	Edison	1275
1	15	Perrett, M. P.	1100
1	15	Maine, M. P.	450
1	20	Eddy, self-oiler	1500
1	20	Perrett, M. P.	700
1	20	Holtzer-Cabot, M.P., enclosed	1150

ALTERNATING CURRENT MOTORS.

SINGLE PHASE. 125-133 CYCLES.

	H.P.		Speed.
10	½	Stanley, 100-110 volts, new	2400
1	½	Holtzer-Cabot, 104 volts	2500
1	½	Emerson, 104 volts	2000
1	½	Wagner, 104 volts, aut.	2000
1	1	Fort Wayne, 104 volts	2500
1	1	Wagner, 208 volts, aut.	2000
1	1½	Wagner, 208 volts, aut.	2000
1	3½	Wagner, 110 volts, automatic	1875

THREE PHASE. 125-133 CYCLES.
For Monocyclic System.

	H.P.		Speed.
1	¾	General Electric, 110 volts	1875

SINGLE PHASE. 60 CYCLES.

	H.P.		Speed.
2	½	Phillips, 104 volts	1800
1	½	General Electric, type I S, 110 v., with type K. S. condenser-compensator, new	1800
1	¾	Gen. Elec., type I. S., form L	1800
1	1	Phillips, 208 volts	1600
1	1	Phillips, 104 volts	1600
1	2	Wagner, 500 volts, aut.	1800
1	2	Wagner, 104 volts	1800
1	15	Wagner, 104 volts, aut.	1200
2	30	Wagner, 104 volts, automatic	1200

FOR SALE.

DIRECT CONNECTED.

30-K.W. Eddy dynamo to Watertown engine, 110 volts.
10-K.W. Westinghouse dynamo to Armington & Sims engine, 110 volts.
10-K.W. Westinghouse dynamo to Westinghouse engine, 110 volts.
80-Amp. Edison dynamo to Brotherhood engine, 80 volts.
20-H.P. Elektron 220 volt motor to Morse Williams freight elevator.

BELTED.

60-amp. Crocker-Wheeler to Herresoff engine, 110 volts.
2000 volt Electro Dynamic arc dynamo, 10 amperes.
500-Lt. Edison dynamo, 110 volts.
60-amp. Westinghouse dynamo to Westinghouse engine, 110 volts.
35-amp. Sprague dynamo to Hornby Ackroyd oil engine.
600-Lt. Weston dynamo, 110 volts.
500-Lt. Edison Dynamo, 110 volts, D.C. to Brotherhood engine.
400-Lt. Excelsior dynamo, 110 volts.
45-H.P. C. & C. motor, 230 volts.
30-H.P. C. & C. motor, 230 volts.
15-H.P. Thomson-Houston motor, 500 volts, with spare armature.
15 General Electric, 2-H.P., 220 volt motors.
12 Siemens & Halske 5-H.P., 220 volt motors, 220 volts, 1550 R.P.M.
2 search lights.

These motors are dust proof and series wound.

Large stock of smaller dynamos and motors.

Repairing of electrical machinery in all its branches.

JORDAN BROS., 74 Beekman St., N. Y.

GENERATORS.

1—180-K.W. General Electric, 60 cycle, single phase.
2—120-K.W. General Electric, 60 cycle, single phase.
1—120-K.W. Westinghouse, 60 cycle, two phase.
360-K.W., 150-K.W., 120-K.W. and 75-K.W., sizes in 125 cycle alternators.
1—100-K.W. General Electric, 8 pole, 125 volt generator, direct connected to 15½ x 15 engine.
175-K.W., 150-K.W., 100-K.W., 75-K.W. and 30-K.W., sizes in direct current generators, 140 and 250 volts.
1—200-K.W. Westinghouse Railway Generator.

ENGINES.

1—Brand New 18 x 16 American Ball Automatic Engine, ready to ship.
1—16 x 30 x 48 Cooper Cross-compound, Condensing Corliss.
1—22 x 48 Allis Corliss, with heavy sectional band wheel.
1—18⅜ x 30 Buckeye, Class 'A."

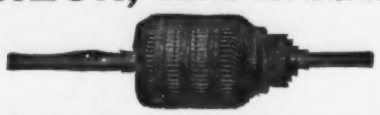
Write for List No. 42 of Dynamos, Engines and Boilers.

STATION EQUIPMENT COMPANY, 204 DEARBORN ST., CHICAGO.

LOUIS HECK,

Successor to STUCKY & HECK, ELECTRICAL MANUFACTURING CO., Lit'd.

Electrical and Mechanical Engineers and Draughtsman



Every System—Repairing, Re-winding, Re-construction

Telephone No. 977

35 N. J. RAILROAD AVE., Opp. Market St. Railroad Depot, NEWARK, N. J.

MATERIALS FOR THE

PERMANENT INSULATION OF ELECTRIC COILS

(1) DIELECTRIC MNFG. CO., SAINT LOUIS

JOHN A. STRALEY.
LOUIS B. HASBROUCK.
G. AUGUSTUS DIETERICH.

STRALEY, HASBROUCK & SCHLOEDER, COUNSELORS AT LAW, Solicitors of American and Foreign Patents

PATENTS AND PATENT CAUSES

257 BROADWAY, NEW YORK, N. Y.

PATENTS, DESIGNS, TRADEMARKS, LABELS AND COPYRIGHTS.

Dynamos and Motors

Bought, Sold and installed
Electrical Repairs

A. J. RUEL
NO. ADAMS, MASS.

MOTORS FOR SALE

75 H.P.

Several direct-current, 250-volt, slow-speed, compound-wound Crocker-Wheeler motors for sale.

D'OLIER ENGINEERING CO.,
119 So. 11th St., Philadelphia, Pa.

You can increase the efficiency of your advertising by sending us NEW CUTS frequently.

Dynamo and Motor Repairing

Armature Winding, Armature Coils. Commutators, Gears and Pinions.

Our Specialty **Railway Field Coils** of Every Type

The ELLIOTT BROS. ELECTRIC CO.
Cleveland, O.

WANTED

INVENTORS PATENTS

PROTECT YOUR INVENTION NOW.

18 PROFESSORS, 48 Members and 25 Asso. Mem. A. I. E. E.; 92 other electrical men; 40 Stevens alumni and 110 other alumni; and 24 Mem. A. S. M. E. are among my clients.

WARNING. A solicitor who knows only "general electric principles" can no more draft an expert patent specification or proper technical claims, than he could write a technical book or be a full member of the above named societies.

FIRST STEP MAIL THIS page, with address in margin, to EDWARD P. THOMPSON, registered patent attorney, 156 Fifth Ave, N. Y. (the only patent attorney who is a member of both said societies) and receive 75 recommendations from members and professors; *pro rata* estimates; sample copies of patents obtained through me; instructions; information; and address of nearest representative, (50 branch offices).

If you do not know who makes what you want to buy, consult the advertising pages of ELECTRICAL WORLD AND ENGINEER.

ELECTRIC LIGHT PLANT, VERSAILLES, MISSOURI.

Sealed proposals will be received at the office of the Mayor of the City of Versailles, Missouri, until 1 P. M., April 26, 1904, and then opened, for the furnishing of all labor, material and equipment necessary for installing a complete electric lighting plant, consisting of the following:

Brick power house, storage reservoir, one 11" x 12" simple high-speed engine, one 60-kw. alternator, one 54" x 16' tubular boiler, 70' steel stack and breeching, jet condenser, feed water heater, all necessary piping, 24 arc lamps, wire, poles, cross arms, transformers, etc.

A certified check for 10 per cent. of the amount of each bid, payable to A. G. Baker, Secretary Board of Public Works, must accompany each proposal or bid. Successful bidders must give bond for 50 per cent. of the amounts of their contracts.

Plans, specifications and instructions to bidders are on file for examination by prospective bidders at the office of A. G. Baker, Secretary Board of Public Works, Versailles, Missouri, and W. K. Palmer, Consulting Engineer, 402 Lyceum Building, Kansas City, Missouri. Copies of these will be furnished to parties desiring them at cost of preparation by the Consulting Engineer upon receipt of request, stating the particular parts of the work upon which proposals are to be made.

A. G. BAKER,
Secretary Board of Public Works,
VERSAILLES, MISSOURI.

TO BE SOLD

April 22.—Plant and rights of Pawnee Electric Company; Corliss 16 in. x 36 in. engine; Stanley 90-K.W. alternator; pole-line; station, etc. In good town, County Seat, 3,000 population, 6 blocks business, 2 railroads; good opening for practical man with funds to make necessary extensions, or to put in combination ice and light plant. Address,

Trustee, Box No. 194,
Pawnee, Oklahoma.

WANTED FOR CASH

Dynamos, motors, arc lamps and transformers.

FOR SALE AT A BARGAIN

25 K.W. direct connected C. and C. to Fisher engine.

EMIL LEVENE,
114 Girard Ave. Phila. Pa.

If you want to do business with any man in the electrical field in any part of the world the right medium to advertise in is ELECTRICAL WORLD AND ENGINEER.

WANTED

Copies of the following periodicals. (If not for sale, should like to obtain loan of same for a few weeks.)

The Operator, Vol. I, No. I, 1874.
The Electrical Engineer, Vol. VII, No. I, January, 1898.
The Electrical World, Vol. XXIII, No. I, January 6, 1894.
The Electrical World & Engineer, Vol. XXXIII, No. 10, March 11, 1899.

ELECTRICAL WORLD & ENGINEER,
114 LIBERTY STREET, NEW YORK

PROPOSALS

In virtue of a resolution of the Municipal Council of San Luis Potosi, approved by the superior Government of the State, contractors for electric lighting are invited to present their propositions for the public illumination of this city, with the understanding that the contract that may be made shall be based upon the following clauses:

I. The contractor by himself, or through the company or companies he may organize, shall establish in this city an Electrical Plant according to the latest and most adequate system in the opinion of such experts as the commission of this department shall duly appoint.

II. He shall be bound to establish by the last day of the present year the service of the illumination with a number of arc lights which shall not be less than one hundred and fifty, distributed according to the plan which shall be given him by the commission of illumination, who shall have the power to modify this distribution whenever it should be necessary within a reasonable term determined by same.

III. These lights shall illuminate daily from the setting of the sun until its rising on the following day.

IV. The contract shall be made for no less than fifteen years, and shall not be rescindable, except in the cases provided for by the law or by mutual consent between the contracting parties.

V. The price per light or for all the lights contracted for, shall be paid by the Municipal Council at the end of each month.

VI. The enterprise that shall have the preference shall make use of the streets, squares and other public places for their conductors, etc., in accordance with the respective commissions taking in consideration the concessions granted previously. Their plant shall be established outside of the perimeter marked out by the respective commissions.

VII. Said enterprise, within a month after the acceptance of their propositions, shall guarantee the fulfilment of their obligations by making a deposit of five thousand pesos in favor and to the satisfaction of the Municipal Council.

VIII. In said propositions mention must be made of the systems adopted for the lighting and installations, the power of each light and apparatus to show same, the price asked for, and, in short, all the details of the business.

IX. Upon making the agreement, details shall be also given as to the terms to be adopted, the capital to be paid out, the streets and other public places that may be used and penalties for the contracting parties, etc., etc.

X. This convocation shall be closed on the fifteenth of May of the present year and shall be published in the Republic as well as in the United States and in Europe.

SAN LUIS POTOSI, Mexico, Feb., 1904.
(Signed) ENRIQUE MILÁN, Sec'y.

In writing to advertisers please mention ELECTRICAL WORLD AND ENGINEER

For Sale. DIRECT CONNECTED APPARATUS

Direct Connected Direct Current
125 TO 250 VOLTS

1—425-K.W. unit consisting of two 210-K.W. 140-volt MP engine type General Electric generators, 130 R.P.M., direct connected to one 24 x36 Wright Corliss engine, for use on 125 or 250-volt circuit.

1—160-K.W. unit consisting of two 80-K.W. engine type MP 6 80-230 R.P.M. General Electric generators mounted on one base and direct connected to one 15 and 25x 16 horizontal tandem compound automatic Ball engine, 125 to 250 volts Edison three-wire system.

1—150-K.W. 110-volt MP 6 engine type General Electric generator direct connected to one 14 and 21x36 Penna. Iron Works tandem compound Corliss engine, 102 R.P.M.

2—150-K.W. 125-volt MP 8 150-225 R.P.M. latest type vertical split frame Westinghouse generators direct connected to two 18x16 simple horizontal 4-valve Corliss type steam jacketed cylinder Ball & Wood engines. These outfits are brand new. Immediate delivery.

1—125-K.W. 125-volt MP Siemans-Halske generator direct connected to simple engine.

1—75-K.W. 125-volt MP 6 engine type General Electric generator, 270 R.P.M., direct connected to one 14 x14 Ideal horizontal centre crank, high speed, automatic engine.

1—75-K.W. 125-volt MP 6, latest engine type Westinghouse generator, 275 R.P.M., direct connected to one 13x12 Ball & Wood centre crank, high speed automatic, simple engine.

1—60-K.W. 125-volt MP 6 60-280 R.P.M. engine type General Electric generator, direct connected to 12x12 Armington & Sims horizontal, centre crank, high speed, automatic engine, with new type governor.

1—62½-K.W. 250-volt MP 6 engine type Bullock generator, 275 R.P.M., direct connected to 14x12 Ames horizontal, centre crank, high speed, automatic engine.

1—50-K.W. 125-volt MP engine type G.I. generator, 300 R.P.M., direct connected to one 12x12 horizontal high speed Russell engine, with Rites governor. Brand new.

2—42-K.W. 125-volt engine type Westinghouse MP generators, direct connected to two 12x12 horizontal, high speed Alfree engines.

1—50-K.W. unit consisting of two 25-K.W. MP 6 engine type General Electric, 305 R.P.M., direct connected to one 11x12 simple horizontal, high speed Ball engine, for use on Edison 3-wire 125 or 250-volt circuit.

1—30-K.W. 125-volt engine type Westinghouse generator, 300 R.P.M., direct connected to one 11x10 simple, horizontal, automatic high speed Ball engine.

IMMEDIATE SHIPMENT
IN STOCK Jersey City and St. Louis Factories

1—25-K.W. MP 6 125-volt engine type General Electric generator, 360 R.P.M., direct connected to 8 and 13x8 Westinghouse vertical compound engine.

1—20-K.W. 125-volt MP 4 engine type Triumph generator, 350 R.P.M., direct connected to one 8x10 horizontal, high speed, automatic Chandler & Taylor engine.

1—12½-K.W. 125-volt Sprague Lundell type generator, 280 R.P.M., direct connected to one 20-H.P. two-cylinder National Meter Company's gas engine. This outfit is practically new.

1—10-K.W. 125-volt MP engine type Eddy generator, 400 R.P.M., direct connected to Wm. Bagley & Sons vertical, automatic, high speed engine.

ROSSITER, MacGOVERN & CO.,

FACTORIES Jersey City, N. J. St. Louis, Mo
MAIN OFFICE: Whitehall Building, 17 Battery Place, New York City.
BRANCH OFFICES: 84 State St., Boston. Papin St. and Compton Ave., St. Louis, Mo.

(*Continued from page 56.*)

POSITION WANTED.—With lighting and power company to locate trouble or take charge meter department by a technical graduate, 28; four years testing, alternating and direct current motors, generators, watt-hour meters and other devices; A1 record with General Electric and Westinghouse Companies; also three years' practical experience on steam side; no license. Address No. 1429, care Electrical World and Engineer, New York.

POSITION WANTED.—Wanted to represent manufacturer of good line electric light, power or street railway specialties in New York, Philadelphia and vicinity by salesman well acquainted with the business. Address No. 1430, care Electrical World and Engineer, New York.

POSITION WANTED.—By young man, graduate electrical engineer, International Correspondence Schools; at present superintendent of 300-hp electric light plant in small town; desires to change his position for similar one in another locality or electrician for manufacturing company; has installed factory plants. Address No. 1431, care Electrical World and Engineer, New York.

HELP WANTED.

The rate for "Help Wanted" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittance and copy should reach this office not later than Tuesday morning for the next succeeding issue.

WANTED.—Three experienced incandescent lamp salesmen, by an old and well established company not in the Trust; applicants will please state age, experience and salary wanted. Address No. 835, care Electrical World and Engineer, New York.

WANTED IMMEDIATELY.—Competent foreman to take charge of work on switchboards and panel boards; must be thoroughly familiar with the work and have had practical experience in working to drawings; give experience, references and salary expected. Address No. 1397, care Electrical World and Engineer, New York.

WANTED.—Energetic young man with some electrical experience and ability as salesman to sell line of insulating varnishes. Reply, stating experience, reference and salary wanted. Address No. 1418, care Electrical World and Engineer, New York.

WANTED.—Three experienced salesmen of ability in sale of electrical apparatus, with fair technical knowledge, to sell electrical lamps. State age, experience, references and salary required. Address "Sales," P. O. Box 1225, Pittsburg, Pa.

WANTED.—Man of about 25, married or single, with fair theoretical knowledge and practical experience, to look after inside wiring, line, meters, arcs, storage battery, automatic telephone exchange (experience in latter not necessary); must also be able to look after the electrical end of station during absence of manager; must be honest, energetic, faithful and care more about getting on in the world than drinking liquor. Salary $125 per month; living expenses (room and board $50 to $65); traveling expenses will be advanced if required; an easy berth, pleasant associations, chance for a foothold in a new country. Address, stating age and experience, and giving references from present or last employers, The Yukon Electrical Co., Ltd., White Horse, Yukon Territory.

WANTED.—A1 traveler to handle new electrical device as side line, good seller; one hundred dollars per month guaranteed; must be willing to invest from one to two thousand dollars in light manufacturing business; references required. Address No. 1422, care Electrical World and Engineer, New York.

Interior View of Wm. Cramp Sons Co. Ship and Engine Building

American Bridge Company of New York

STRUCTURAL STEEL FOR EVERY PURPOSE | ENGINEERS AND CONTRACTORS

OFFICES:

EASTERN DIVISION: 100 Broadway, New York
PITTSBURG DIVISION: Frick Building, Pittsburg, Pa.
WESTERN DIVISION: 1315 Monadnock Block, Chicago, Ill.
Lullibridge, N. Y., 21—1356

WANTED.—Technical man in every town; no goods to sell; no expense. Professional branch of your occupation. Men appointed so far are professors, electrical and mechanical engineers and literary electricians. Address No. 1404, care of Electrical World and Engineer, New York.

WANTED.—First-class foreman or superintendent for incandescent lamp factory to go abroad; requirements, good executive ability, long experience and thorough acquaintance with latest methods of manufacturing; state qualifications, encumbrances and salary expected; in confidence, if necessary. Address No. 1419, care Electrical World and Engineer, New York.

A GOOD POSITION,

is always open to a competent man. His difficulty is to find it. We have openings and receive daily calls for Secretaries and Treasurers of business houses, Superintendents, Managers, Engineers, Expert Bookkeepers, Traveling Salesmen; Executive, Clerical and Technical positions of all kinds, paying from $1,000 to $10,000 a year. Write for plan and booklet. (1)

HAPGOODS (Inc.),
Suite 511, 309 Broadway, New York.

Write for our Catalogue of Electrical Books

BOOKS

ON ANY ELECTRICAL SUBJECT

sent, prepaid, to any address in the world, upon receipt of price.

SEND FOR CATALOGUE

McGraw Publishing Co.

BOOK DEPARTMENT

114 Liberty St. New York

To the Point

For Bargains of Distinctly Better Quality

Direct Connected Units.

1—400-amp. 110 volt compound "Daevel," marine type.
1—25-K.W. G. E. MacIntosh & Seymour engine.
1—40-K.W. "Wood" to "Atlas" engine.
1—50-K.W. G. E. "Ideal" engine.
1—75-K.W. G. E. "Ideal" engine.
1—75-K.W. 220 volt American Ball to American Ball engine.
2—225-K.W. Westinghouse to Westinghouse engine.
1—375-K.W. Westinghouse to Westinghouse engine.

220 Volt Motors

1, 2, 3, 5, 7½, 10, 15, 20, 25, 35, 50-H.P.

A. C. Motors.

1, 3, 5, 10, 20, 30, 50-H.P.

110 Volt Motors.

1, 3, 5, 10, 20, 30, 50-H.P.

We also have a full line of engines, generators, boilers, central station and other apparatus. High-class repairing. *Correspond with us, buy or sell.*

THOMPSON-BONNEY CO.
45 York St., BROOKLYN, N. Y.

PARTNER WANTED

By engineer having agencies for U. S. and Europe; first-class lines of electrical and street railway supplies; large acquaintance with leading railway officials, manufacturers and contractors here and abroad; $20,000 to $30,000 required, to be controlled by partner; net profits estimated at 30 to 40 per cent.; proposed offices New York and London. Address No. 1300, care Electrical World and Engineer, New York.

WANTED

200 to 400 kw. 60-cycle 2 or 3-phase alternator, 2300 volts, direct connected to compound engine. Must be first-class apparatus, in good condition. Address No. 1417; care Electrical World and Engineer, New York.

WANTED

Parties having good patents in mechanical line, or desiring to secure backing to get patents and manufacturing the devices, will do well to correspond with us. We are prepared to manufacture anything meritorious, on partnership or royalty basis, or purchase outright. The Hawley Down Draft Furnace Co., Chicago—New York.

WANTED

To correspond with a thoroughly competent and practical man with the ability to handle a general electric and mechanical repair business with the view of buying interest in a well established concern located in a growing city of 75,000 in one of the Central States; good character and habits essential. Address No. 1420, care Electrical World and Engineer, New York.

ARCHER, GEO. F., E. E.
Engineering Projects Financed.
Meritorious Inventions Exploited.
Specialist on Intercommunicating Telephone Systems.
Steam Plants and Electric Plants.
150 NASSAU STREET, NEW YORK

ARNOLD ELECTRIC POWER STATION COMPANY,
Engineers, Contractors
MARQUETTE BUILDING, CHICAGO.
Designers & Builders of Complete Electric Railway, Lighting & Power Installations.
TRANSIT BUILDING, NEW YORK.

F. M. ASHLEY. PHILIP K. STERN.
ASHLEY & STERN,
Consulting Electrical and Mechanical Engineers and Solicitors of Patents.
Experts in Patent Litigation. Inventions developed.
130 FULTON ST., NEW YORK.
Telephone, 5876 Cortlandt.

W. E. BAKER H. R. BISHOP
BAKER & CO., W. E.
Engineers
27 WILLIAM ST. NEW YORK

BARSTOW, WILLIAM S.
Consulting Electrical Engineer.
56-58 PINE ST., NEW YORK.
Examinations and Reports on Electric Properties. Estimates, Specifications and Plans for Electric Lighting, Power and Railway Plants.
Telephone 2730 John.
Western Office "The Portland," Portland, Oregon.

BEEBE AND BENNETT
Engineers and Contractors
Consulting and Contracting Electrical and Mechanical Engineers.
Illumination Experts, Expert Opinions and Reports.
2210 FARMERS' BANK BLDG., PITTSBURG, PA.

CHAS. L. BROWN, PRESIDENT. STUART H. BROWN, SECY. AND TREAS.
BROWN ELECTRICAL CONSTRUCTION CO.
505 ELLSWORTH BLDG.
355 DEARBORN ST., CHICAGO.
Telephones { Harrison 3698 / Automatic 3698

BURCH, EDWARD P.
Electric Railway Engineer.
Plans for New Railways.
Betterment of Existing Systems.
Engineering and Financial Examinations.
1222 GUARANTY BLDG., MINNEAPOLIS.

BYLLESBY, H. M., & CO.
(Incorporated)
Engineers
Design, Construct and Operate Railway, Light, Power and Hydraulic Plants.
Examinations and Reports.
NEW YORK LIFE BUILDING, CHICAGO, ILL.

C. W. CARMAN. M. C. HARTMAN.
CARMAN & CO., C. W.
Engineers
88 LA SALLE ST., CHICAGO.

CHAPMAN, CHARLES A.
Consulting Engineer.
Rooms 1040-42 204 DEARBORN ST. CHICAGO.

COHO & COMPANY, H. B., Inc
Civil, Electrical and Mechanical Engineers
Contractors for Complete Electric, Hydraulic and Steam Installations, Railways
114-118 LIBERTY STREET NEW YORK

CORSON, Wm. R. C.
Consulting Engineer.
Plans, specifications, superintendence of factory, power and lighting installations.
Investigations of electrolysis of underground structures. Electric machine design.
Reports. Laboratory tests and experiments.
36 PEARL ST. HARTFORD, CONN.

DOBLE, ROBERT McF.
Consulting and Supervising Engineer
Specialty: Hydro-Electric Power Development and Long Distance Transmission.
417 RIALTO BUILDING,
SAN FRANCISCO. CALIFORNIA.

FORD, BACON & DAVIS,
ENGINEERS.
24 Broad Street, New York.
BRANCH OFFICES.
2104 First Avenue, Birmingham, Ala.
1500 Grand Avenue, Kansas City, Mo.
331 N. College St., Nashville, Tenn.

FOSTER, HORATIO A.
Electrical and Mechanical Engineer
Consultation, preliminary reports, specifications and plans for new projects. Investigation of lighting, railway and power properties for investment purposes. Organization and application of accounting systems for central stations, street railways, etc.
650 BULLITT BUILDING, PHILADELPHIA, PA.

E. W. HAMMER, Pres. & Treas. H. J. MINHINNICK, Sec. & Gen'l Sup't
GENERAL ENGINEERING CO., THE
Consulting and Contracting Engineers
Telephones—Electric Light—Power Transmission.
SUITE 1112, 135 ADAMS ST., CHICAGO.
Long Distance Telephone Central 478.

HANCHETT, GEO. T.
Consulting and Electrical Engineer.
114 LIBERTY STREET, NEW YORK.

HORRY, WILLIAM SMITH
Consulting Electrician and Engineer.
Designer of Electrical Machinery. Specialty, Thermo-Electric Furnaces and Automatic Regulators for same.
UNION CARBIDE WORKS,
NIAGARA FALLS, N. Y.

ROBERT E. HUTTON. G. H. HUTTON, JR.
HUTTON ENG'G CO., THE
LEXINGTON, VA.
BALTIMORE, MD.
Consulting and Contracting Electrical and Mechanical Engineers.
Central Stations, Electric Railways, Steam and Power Plants

IRON CITY ENGINEERING CO.
Contracting Electrical Engineers.
Power and Light Installations.
BELL L. D. TEL. 1599 COURT.
FRICK BLDG., PITTSBURG, PA.

JACKSON, DUGALD C., C. E.
JACKSON, WILLIAM B., M. E.
MEMBERS
American Institute of Electrical Engineers
American Society of Mechanical Engineers
American Society of Civil Engineers
Engineers. Experts.
MADISON, WIS.

KELLY ENGINEERING CO., THE JOHN F.
Consulting and Contracting Engineers
149 BROADWAY, - - - NEW YORK.
'Phone-7259 Cortlandt.

KOHLER BROTHERS
G. A. EDWARD KOHLER. FRANKLIN W. KOHLER.
Contracting Electrical Engineers
Lighting, Power, Railways.
1804-1806-1808-1810-1812 FISHER BUILDING, CHICAGO.

THE CLARK DIAL
"THE KEY TO THE SITUATION."

For Small Installations.

THE CLARK SYSTEM—

Is simple, durable and efficient.—
Avoids all central office expense,—
Avoids complexity of wiring of the plug system,—
Permits connections at will of party calling,—
Allows any number of conversations at same time.—

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD CO.,
15 Custom House Street, PROVIDENCE, R. I. (1)

LANSINGH, VAN RENSSELAER.
Illuminating and Electrical Engineer
Specialty: The design of illumination for hotels, office buildings, public edifices, etc.
211 JACKSON BOULEVARD, CHICAGO.
Telephone—Harrison 2104.

MAILLOUX, C. O.
Consulting Electrical Engineer,
76 WILLIAM STREET, NEW YORK.

MASSON, R. S.
Consulting Electrical Engineer.
232 CROCKER BLDG. San Francisco, Cal.
706 LANKERSHIM BLDG. Los Angeles, Cal.

MUNROE, HALL & HOPKINS,
Chemical and Electrochemical Engineers
OFFICE, BOND BUILDING, WASHINGTON, D. C.
Plants designed and erected for the manufacture of Sulphuric Acid, Nitric Acid, Mixed Acids for Explosives, Dynamite, Smokeless Powder and other Explosives, the recovery and concentration of spent acids.

MURALT & CO.
Engineers and Contractors,
25 PINE STREET, NEW YORK.
Complete Electric Plants. Alternating Current Systems a Specialty.

PALMER, W. K., M. E.
Consulting Engineer
HOME PHONE 3322 MAIN. BELL PHONE 3112 RED.
Mechanical and Electrical Engineering.
Electric Railways, and Lighting; Power Plants; Manufacturing Establishments; Heating, Ventilating and Refrigerating Systems; Designing of Machinery; Patent Work; Inspections, Tests and Reports.
402 LYCEUM BUILDING, KANSAS CITY, MO.

PATTERSON, H. C.,
Mechanical, Electrical
and Hydraulic Engineer,
17 STATE STREET, NEW YORK.

PEPPER & REGISTER,
General Contractors
112-116 N. BROAD ST., PHILADELPHIA, PA.
Electric Street Railways a Specialty.

PIERCE, Richardson & Neiler
Consulting and Designing Engineers
R. H. Pierce
S. G. Neiler
H. A. Robinson
MANHATTAN BUILDING, CHICAGO.
110 STATE STREET, BOSTON.

POWER INSTALLATION CO.
Engineers
Complete Power Plants Designed and Constructed
GEORGE F. WESCOTT
BUFFALO, N. Y.

PRATT, CHARLES R.
M. AM. SOC. M. E.
VAN WINKLE, EDWARD
Consulting Engineers.
Shop Management, Machine Design and Manufacture, Elevator and Traveling Stairway.
160 FIFTH AVE., NEW YORK.
Telephone 807 Gramercy.

PRATT & ATKINS
Engineers
Electrical, Steam, Mechanical.
1000-1001 MONADNOCK BLDG., CHICAGO.

SANDERSON & PORTER,
Engineers and Contractors,
Electric Railways, Light, Power and Hydraulic Plants.
52 WILLIAM STREET, NEW YORK.

SARGENT & LUNDY,
Engineers,
1000-46 E. VAN BUREN ST., Chicago.
FREDERICK SARGENT. A. D. LUNDY.

SCHOTT, W. H.
Engineer and Contractor
1220-21 MARQUETTE BUILDING, CHICAGO.
Specialties.—Central Station Heating Plants, Water Works, Steam Plants, Electric Light, Gas and Street Railway Plants.

SHEAFF & JAASTAD,
Mechanical and Electrical Engineers.
Plans and specifications for and superintendence of Electric Power and Lighting Plants a specialty.
85 WATER STREET, BOSTON, MASS.

STANTON, LE ROY W.
Consulting Telephone Engineer
Plans, Specifications and Supervision of Installation of complete telephone plants.
Special Reports on Telephone Properties and Apparatus.
411 ELECTRICAL BLDG., CLEVELAND, OHIO

WAGNER, HERBERT A.
Consulting Electrical and Mechanical Engineer
Railway, Lighting & Power Plants.
Specialty, Distribution.
TIMES BLDG., NEW YORK CITY.
415 LOCUST ST., ST. LOUIS.

WHITE & COMPANY, J. G.,
Incorporated.
Engineers, Contractors
43-49 EXCHANGE PLACE, NEW YORK, N. Y.
London Correspondent:
J. G. White & Company, Limited,
22a College Hill, Cannon St.

WHITTED, THOMAS B.,
Consulting Electrical and Mechanical Engineer,
Railway, Lighting and Power.
Plans, Reports, Specifications, Superintendence of Transmission work and Electrical Equipment of Mines a Specialty.
516 MAJESTIC BLDG., DENVER, COLO.

THE PROFESSIONAL DIRECTORY
of
ELECTRICAL WORLD and ENGINEER
introduces engineers to a larger clientele than any other publication.

Hertner Electric Co.
MOTORS
For Power Elevators, Automobiles
CLEVELAND, O.

CHICAGO EDISON COMPANY
REPAIR SHOPS
76 MARKET STREET, CHICAGO. TELEPHONE MAIN 1280.
FIRST-CLASS EQUIPMENT THROUGHOUT.
OPEN DAY AND NIGHT
DYNAMOS, ARMATURES, MOTORS, ARC LAMPS, INSTRUMENTS; MACHINE AND CARPENTER WORK OF ALL KINDS.
CORRESPONDENCE SOLICITED.

If you want to do business with any man in the electrical field in any part of the world, the right medium to advertise in is Electrical World and Engineer.

All Right on the Inside
Telephones of Quality
Try these telephones and cut down your repairs
FOR PARTICULARS WRITE
The North Electric Co.
CLEVELAND, OHIO
147-157 St. Clair St. C N 156

THE CALCULAGRAPH

Guessing on the cost of factory products.

Subtracts

the time of commencing from the time of finishing and prints the difference—the *elapsed time*—the number of hours and minutes a man works, and

It Makes No Clerical Errors

One instrument makes such records for all workmen in a department. The records may be made on cards containing the work order, that are adapted for use in the modern filing cabinets.

"Sure Thing."
No Guess-work here.

They Are Individual Records

The card system of keeping records is the most flexible of any known method. It makes possible a division of the labor of tabulating and compiling so as to get quick results.

Calculagraph Record Cards

may be assembled so as to bring together, without posting, the labor of all persons employed on a given product, to determine the cost of that product.

SEND FOR BOOKLET

Calculagraph Company

1412 JEWELERS BUILDING, NEW YORK, U. S. A.

THE

American Bell Telephone Company,

125 Milk Street, Boston, Mass.

FRANK B. COOK

CABLE TERMINALS

AND

TELEPHONE PROTECTIVE APPARATUS

of my well known standard types, for both Central Office and Subscribers' Stations. Over 500,000 in use. Covered by U. S. Letters Patents.

240-244 West Lake St., - Chicago, U. S. A.

Write for Catalogue. Correspondence solicited.

American Independents Guaranteed

AGAINST ENCROACHMENT BY USE OF OUR APPARATUS

CENTRAL ENERGY
OR
MAGNETO : : 1 to 10,000 lines

AMERICAN ELECTRIC TELEPHONE CO.
CHICAGO.

LEICH POUR-PARTY SELECTIVE SYSTEM

Largest Independent Telephone Manufacturers in the World

WIRELESS TELEGRAPH INSTRUMENTS

Complete sets of instruments for **Students, Experimenters, Colleges and Universities** from **$10.00** to **$50.00. Standard Sets** for commercial telegraphing from 1 mile to 150 miles quoted on application, and supplied on short notice. **All** instruments tested before delivery.

Write for prices and bulletins on Wireless Telegraph Instruments, Spark-Plugs, X-Ray Coils, Automomobile Spark Coils, Clark's Patented Show Case Reflector. *Agents wanted.*

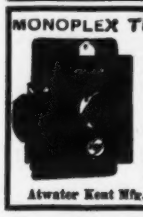
THOS. E. CLARK WIRELESS TELEGRAPH-TELEPHONE CO.

MANUFACTURERS OF HIGH GRADE SPECIALTIES

Main Office, Factory and Laboratory, - - Pontiac, Mich.

MONOPLEX TELEPHONES $2.50 EACH.

Also a Trade Discount.



Monoplex Telephones are the simplest and most reliable instruments now on the market. Thousands are in use, giving perfect service. They are guaranteed for one year.

Intercommunicating Instruments $4.00 per station
Desk Instruments, 6.00 " "
2 end Instruments 2.50 per end.

Atwater Kent Mfg. Co., 120 N. 6th St., Philadelphia.

This Company keeping abreast of the times in everything electrical.

VIADUCT CO.
BALTIMORE, MD. (6)

TELEPHONES Central energy generator call
Multiple Trunking **SWITCHBOARDS**
FOR ANY SIZE EXCHANGE
All we ask is your request for a
SAMPLE AND QUOTATION
INTERNATIONAL TEL. MFG. CO.
Harrison and Clinton, Chicago, U. S. A.

Couch TELEPHONES TRADE MARK
For Any System
For Everybody
S. H. COUCH COMPANY
169 PEARL ST., BOSTON, MASS.

WE PUBLISH IMPORT and DEAL IN

ENGINEERING BOOKS

Electrical, Civil, Mechanical, Mining, Architectural or Chemical.

Send us your inquiries.

McGraw Publishing Company
BOOK DEPARTMENT
114 Liberty St., New York

Efficient Service

at

Reasonable Rates

is rapidly spreading the

Telephone Habit

NEW YORK TELEPHONE COMPANY
15 DEY STREET (1)

CONNECTICUT

STANDS FOR **QUALITY**

MOST COMPLETE LINE APPARATUS EVER OFFERED

TYPE E, DESK PHONE

INTERCOMMUNICATING SYSTEMS
INTERIOR SYSTEMS
BATTERY CALL SYSTEMS
CENTRAL ENERGY TELEPHONES
LONG DISTANCE TELEPHONES

SWITCH-BOARDS
FOR TOLL AND
COUNTRY LINES

EVERY PART OF OUR APPARATUS A FIT COMPANION FOR THE OTHER

Send for Catalog T and see our new PRICES. WE CAN SAVE YOU MONEY

Connecticut Tele. & Elec. Co.

MERIDEN, CONN., U. S. A.

Automatic Telephone Service in Lincoln, Neb.

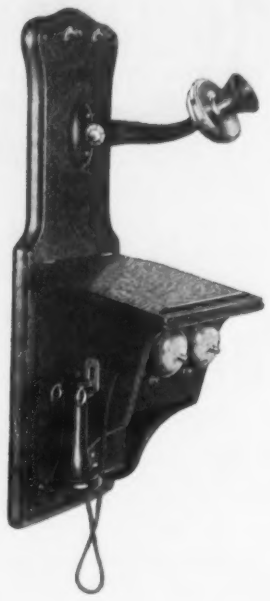
The new 3000-station Automatic exchange installed by the Automatic Electric Company for the Lincoln Telephone Co., began service on March 15th. The entire equipment was installed within six weeks after the exchange building was finished.

Thus another large western city throws off the yoke of telephone monopoly.

Are you interested? Write us.

Automatic Electric Co.

CHICAGO, U. S. A.



ALL KINDS OF TELEPHONES

FOR

ALL KINDS OF SERVICE

Magneto, Series, Bridging, Centralized Calling and Common Battery

NONE BETTER WRITE FOR PRICES

TRADE MARK STERLING ELECTRIC COMPANY.

LA FAYETTE, IND.

Telephone Transmitter Mouthpieces

Highest Grade Material
Perfect Workmanship
Superior Finish
Absolute Resistance to Moisture
Interesting Prices Quoted. Samples Forwarded

CHICAGO OFFICE,
ALBERT J. COX & CO.
1129 First National Bank Bldg.

The Siemon Hard Rubber Corporation
BRIDGEPORT, CONN.

Magnets and all Kinds of Coil Windings of Insulated or Bare Wire for Every Purpose.
VARLEY DUPLEX MAGNET COMPANY, PROVIDENCE, RHODE ISLAND

A Correspondent of Electrical World & Engineer writes:
"It is far superior to all electrical papers published."

"Just as Good as Kellogg Apparatus"

cannot be bought outside our factories for the same price we ask,—for a higher price or for a lower price.

Our customers never think Kellogg prices high.

We are quoting attractive magneto prices. Write us for quotations on everything in the magneto line.

Kellogg Switchboard and Supply Company

Green and Congress Streets, Chicago.

Electric Building
Cleveland

Keystone Telephone Building
Philadelphia

STROMBERG-CARLSON RECEIVER

ALL RUBBER SHELL TYPE

The adjustment is equal to that on our famous No. 3 receiver. The No. 3 has been on the market for more than 10 years.

We stamp our full name on the ear cap. A small thing to look for, but it means a good deal to the purchaser.

Printed matter mailed free upon request. Our Combination Telephone Key fits any make of telephone. We mail it free if you mention this paper.

STROMBERG-CARLSON TEL. MFG. CO.,

Gen'l & Eastern Office, ROCHESTER, N. Y. Sales Dept., CHICAGO, ILL.

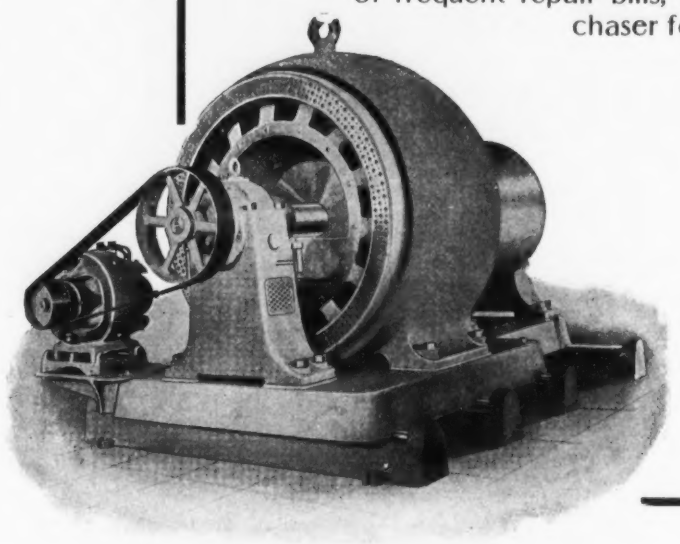
A Good Story

not spoiled by the retelling—

Warren Alternators

haven't a streak of cheapness in their entire make up. The satisfaction that comes of knowing that you can rely on the machine day after day, the absence of frequent repair bills, the high efficiency, more than compensate the purchaser for the perhaps slightly higher first cost.

A postal sent to us will bring you our catalog.



WARREN ELECTRIC MF'G. CO.

SANDUSKY, OHIO, U. S. A.

Rumsey Electrical M'f'r's Co.,
1211 Filbert St., Philadelphia, Pa.

Duncan-Hobson Electric Co.,
Dallas, Texas

A. M. Searles,
1200 Fisher Building, Chicago, Ill.

Carter & Gillespie Electric Co.,
Atlanta, Ga.

Wesco Supply Co.,
St. Louis, Mo.

W. I. Gray & Co.,
Minneapolis, Minn.

C. A. Cotton,
129 Pearl St., Boston, Mass.

H. B. Coho & Company,
114 Liberty St., New York.

G. A. Wilbur Co.,
183 Crocker Bldg., San Francisco, Cal.

Z. C. Miles & Piper,
Seattle, Wash.

FESSENDEN

WIRELESS TELEGRAPH SYSTEM

OPERATION GUARANTEED

Telegraph sets for working up to 150 miles over land or 350 miles over sea can be supplied generally from stock.

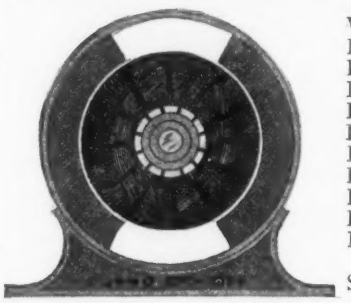
Sets for longer distances supplied at short notice. Sets may be tested by purchaser before delivery. Very speedy and reliable. No coherer.

Low cost of maintenance.

NATIONAL ELECTRIC SIGNALLING CO.

Eighth and Water Streets, Washington, D. C.

Runs on Both Direct and Alternating Current



Without Changing a Nut, Bolt or Screw.
Instantly Reversible on Either Current.
Lower First Cost.
Lower Cost of Maintenance.
Less Space Occupied.
Less Weight.
Efficiency Unsurpassed.
Runs on Any Phase.
Runs on Any Cycle.
Fields Cannot Burn Out.
Peculiarly Adapted for Electric Vehicle, Marine and Street Railway Service.
See Export Editions.

DIALT MOTOR CO.

1429 R. E. TRUST BUILDING, PHILADELPHIA, PA.

OUR LATEST

The Biaphone

WALL SETS $5.00 PER PAIR

Fully guaranteed telephones, highest grades, solid back transmitters.

Double Pole Receivers.

LOWEST PRICES ON ALL STYLES

Send for Catalogue. Big Discounts to Dealers.

The Russell-Tomlinson Electric Co., Danbury, Conn.

B M TYPE MOTORS

ARE ESPECIALLY DESIGNED TO GIVE GOOD SERVICE UNDER THE WORST CONDITIONS. THE NUMBER OF PARTS IS THE MINIMUM. NO EXTERIOR WIRES TO GET BROKEN. ALL PARTS INTERCHANGEABLE AND CAN BE ORDERED FROM FACTORY. BEARINGS SELF OILING. PRICES LOW.

WRITE FOR CATALOGUE DESCRIBING OUR PRODUCTIONS.

GILMORE ELECTRIC CO. (4)

630 First Street, Boston, Mass.

You can increase the efficiency of your advertising by sending us NEW CUTS frequently.

"A Life Lesson"

for every

Industrial Establishment

SOME SALIENT POINTS

of the

Government Printing Office Equipment

at Washington, D. C.

1. The greatest variety of applications of electric motors.
2. Over 600 Crocker-Wheeler motors employed under the one roof.
3. Every printing press motor driven.
4. The printing presses driven range from the largest Hoe presses down to the smallest job presses.
5. Most extensive miscellaneous printing plant equipment in the world.
6. The whole generating plant is Crocker-Wheeler, comprising four units, one of 300 kilowatts, one of 125 kilowatts, and two of 600 kilowatts each.
7. At the generated pressure of 125 volts, there is a total current capacity of 13,000 amperes where the generators run at rated normal load; and they have a continuous overload capacity of 25 per cent for periods of four hours.
8. The Government Printing Office is the largest establishment of the kind in the world and a great deal of the work done is of such vital importance that no possible chance could be taken of a break down of either generators or motors; none but the very best could be adopted for the work.

Crocker-Wheeler Company

MAIN OFFICES AND WORKS: AMPERE, N. J.

Manufacturers of Generators and Motors

Engineers for their efficient application to Industrial Plants

BRANCH OFFICES:

Boston, New Haven, New York, Syracuse, Philadelphia, Washington, Baltimore, Atlanta, Pittsburg, Cincinnati, Cleveland, St. Louis, Chicago, Denver, San Francisco.